EFFICACY OF CORE STABILITY EXERCISE VERSUS TRUNK STABILIZATION EXERCISE COMBINED WITH CONVENTIONAL THERAPY ON RECOVERY OF POSTURAL CONTROL AND BALANCE IN HEMIPLEGIC PATIENTS

Dissertation work submitted to

THE TAMIL NADU DR. M. G. R. MEDICAL UNIVERSITY,

Chennai-32

towards partial fulfillment of the requirements of

MASTER OF PHYSIOTHERAPY

Degree programme

Submitted by

Reg No: 271420208

P.P.G. COLLEGE OF PHYSIOTHERAPY

Coimbatore-641035

www.ppg.edu.in

EFFICACY OF CORE STABILITY EXERCISE VERSUS TRUNK STABILIZATION EXERCISE COMBINED WITH CONVENTIOINAL THERAPY ON RECOVERY OF POSTURAL CONTROL AND BALANCE IN HEMIPLEGIC PATIENTS

Submitted by

Reg No: 271420208

Under the guidance of

Prof. Pratibha M.P.T (Neuro)., MIAP.,

Dissertation submitted to

THE TAMILNADU DR. M. G. R. MEDICAL UNIVERSITY,
Chennai-32.

Dissertation evaluated on -------------------------------------

Internal Examiner   External Examiner

CERTIFICATE I

This is to certify that the dissertation entitled **“ Efficacy Of Core Stability Exercise Versus Trunk Stabilization Exercise Combined With Conventional Therapy On Recovery Of Postural Control And Balance In Hemiplegic Patients ”** was carried out by **Reg. No. 271420208, P.P.G** College of physiotherapy, Coimbatore-35, affiliated to the Tamilnadu Dr. M.G.R medical university, Chennai-32, under the guidance of **Prof. Pratibha, M.P.T (Neuro)., MIAP.,**

Prof. K. Raja Senthil M.P.T (Cardio)., MIAP.,(PhD)

Principal

CERTIFICATE II

This is to certify that the dissertation entitled **" Efficacy Of Core Stability Exercise Versus Trunk Stabilization Exercise Combined With Conventional Therapy On Recovery Of Postural Control And Balance In Hemiplegic Patients "** was carried out by **Reg. No. 271420208, P.P.G** College of physiotherapy, Coimbatore-35, affiliated to the Tamilnadu Dr. M.G.R medical university, Chennai-32, under my guidance and direct submission.

Prof. Pratibha, MPT., MIAP

Guide

ACKNOWLEDGMENT

First and foremost, I thank **Almighty God** for showering me with his divine blessing, enriched love and matchless grace, which gave me inner strength and guidance that carried me throughout my study.

I'm, deeply indebted to each of my parents, for their unconditional love, sincere prayers, unstinted support and care without which I would not have accomplished anything.

I express my sincere gratefulness to **Dr. L. P. Thangavelu, M.S., F.R.C.S**., Chairman and **Mrs. Shanthi Thangavelu, M.A.,** Correspondent, P.P.G group of institutions, Coimbatore, for their encouragement and providing the source for the successful of the study.

With due respect, my most sincere thanks to my principal **Prof. K. Raja Senthil MPT (Cardio-Resp)., MIAP.,(PhD)** who gave me his precious time and with his vast experience helped me to complete this dissertation successfully.

I express my special thanks to my guide **Prof. Pratibha, MPT (Neuro)** for offering me perceptive inputs and guiding me entirely through the course of my work and without her tiredless guidance, support, and constant encouragement this project would not have come through.

My heartfelt thanks to class coordinator **Prof. Shankar S;** and all the **Physiotherapy faculty** members for their guidance and encouragement for my studies.

I extend my gratitude to **Prof. Dr. Madhan Arumugam PhD.,** statistician for his unrelenting devotion and determination for statistical excellence.

I express my thanks to each and every **Subjects** who co-operated to fulfill this dissertation work possible.

LIST OF CONTENTS

LIST OF TABLE

LIST OF GRAPHS

EFFICACY OF CORE STABILITY EXERCISE VERSUS TRUNK STABILIZATION EXERCISE COMBINED WITH CONVENTIOINAL THERAPY ON RECOVERY OF POSTURAL CONTROL AND BALANCE IN HEMIPLEGIC PATIENTS

ABSTRACT

Objective of the Study: To find out the efficacy of Core stability strength exercise and Trunk stabilization exercise on recovery of postural control and balance in sub-acute hemiplegic patients.

Methodology: 30 patients with sub acute stage of hemiplegic patients were assigned into two treatment groups. The first group (n=15) treated with Conventional Physiotherapy with Core stability strength exercise. The second group (n=15) was given Conventional Physiotherapy with Trunk stabilization exercise. The effect of 12 weeks treatment was measured by Trunk Impairment scale score (TIS) and Berg Balance Scale score (BBS).

Result: After 12 week intervention using Conventional Physiotherapy with Trunk stabilization exercise (experimental group -2) had a statistically significant improvement on recovery of postural control and balance in sub-acute hemiplegic patients than conventional Physiotherapy with Core stability strength exercise (experimental group -1).

Conclusion: The study proves that trunk stabilization exercise in addition to the conventional therapy is more effective on recovery of postural control and balance in subacute hemiplegic patient, than the core stability strength exercise along with conventional therapy. So trunk stabilization exercise in addition to the conventional therapy can be used as an effective treatment programme in improving postural control and balance of sub acute hemiplegic patients than receiving core stability strength with conventional physical therapy. This helps the patient to improve the quality of functional independence.

Key words: Stroke, Trunk impairment scale (TIS) and Berg Balance Scale (BBS).

CHAPTER I

INTRODUCTION

1.1 BACKROUND OF THE STUDY

Cerebrovascular accident is a common nervous system disorder that occurs due to abnormal blood circulation in the brain with a completely developed nervous system **(Forster et al., 2008)**. As the survival rate of patients with CVA increased owing to advances in medical technology, CVA became the most common internal cause of disablement **(Barnett et al., 1999)**. In addition, CVA hinders the physical movements of daily life and causes dyspraxia and dysfunctions like cognitive impairment, dysesthesia, speech disorder, and visual impairment (Bobath, 1990). Unilateral paralysis accompanied by CVA reduces muscle control, body movements, and balance in unusual or asymmetrical positions. Thus, patients lose the ability to perform elaborate tasks and face difficulty while walking and standing up **(Carr et al., 1985; Bobath, 1990)**. Moreover, most patients with unilateral paralysis have a tough time controlling their truncus while adjusting their posture.

The core is the biggest part of our body and plays an important role in the stabilization and movement of body segments. The truncus makes it possible for us to maintain posture and enables the movement of legs or arms, opposing gravity. It also contributes to smooth central movement so that our body easily can be changed to new posture **(Ryerson et al., 2008)**. In addition, the common problem of decrease in core muscle function, especially the external muscles, causes paralysis of the core muscle, decreases contraction, and increases the tendency to fall towards the paralyzed side, causing asymmetry. Because CVA reduces the quality of life by severely affecting balance and walking, which are the basic requirements for any physical activity, affected patients experience a huge sense of loss **(Handa et al., 2000)**. Accordingly, physiotherapists should focus on dyspraxia and rehabilitation for balance and gait so that patients with brain damage can live an independent and functional life. Since long, the prognosis of CVA has been determined according to the part and size of lesion. However, since the concept of brain plasticity became known, physicians are aware that the patients' degree of recovery can differ according to the quality of the rehabilitation program **(Bach-y-Rita, 1981).**

Core stability is usually used to strengthen the muscles around the abdominal, lumbar, and pelvic regions, because the muscles of these regions play an important role in stability as well as in controlling the lumbar posture by using tonic or postural muscles during whole-body exercises **(Marshall and Murphy, 2005)**. The following muscles are related to core stability: multifidus, transversus abdominis, external/internal oblique abdominis, paraspinalis, gluteus, diaphragm in rear part, and hip muscles. The ventral muscles, multifidus, transversus abdominis, and oblique abdominis, provide core stability via cooperative contraction before moving out. The multifidus muscle serves as the intersegmental muscle placed on spiral part, followed by the interspinales and intertransverse muscles.

These muscles control movement of the spinal units while lifting things and while rotating the core. Additionally, owing to the short length of these muscles, the reaction time is very rapid and this is highly important for maintaining stability (**Kim and Kwon, 2001)**. Although muscles related to core stability have individual roles, they function in concert via cooperative contraction to establish core stability **(Richardson et al., 1995).** Core stability is a prerequisite for maintaining the proper posture of the lumbar and pelvic regions during sports activities. Exercises for core stability serve as treatment for simultaneously activating the abdominal and multifidus muscles in order to stabilize the body and head during the beginning of limb movements and during the course of these movements **(Hodges and Richardson, 1997)**.

The cooperative contractions of transversus abdominis and multifidus muscles improve the stability of each part when the spine is in neutral position or in motion **(Porterfield et al., 1998)**. Patients with CVA lack selective movement control and thus the order of muscle movement is changed. These patients thus move in an unusual pattern, which results in much waste of energy and malfunctioning movement pattern. Although patients with CVA need to rebuild core stability in order to attain proper postures of the lumbar and pelvic regions during sports activities, most researches are conducted on athletes or patients with backache; research on patients with CVA is scarce **(Rasmussen et al., 2003)**.

The recovery of independence following stroke is a complex process requiring the reacquisition of many skills. Since controlling the body's position in space is essential part of functional skills, restoration of balance is a critical part of the recovery of ability after stroke. An important cause of balance impairment in patients with stroke hemiparesis is a deficit of the central integration of sensory inputs (somatosensory, visual and vestibular). In normal adult subjects, the visual, vestibular and somatosensory systems are all involved in balance control and make up the system of coordinates on which the body's postural control is based **(Sullivan B. O' Sullivan et al, 2006).**

The somatosensory system provides the CNS with position and motion information about the body with reference to supporting surfaces. Also somatosensory inputs throughout the body report information about the relationship of body segment to one another and hence maintaining balance. Since stroke subjects often present with somatosensory deficits, the adaptation of regular exercises with the use of surface and vision manipulation to challenge balance could improve the process of somatosensory integration and have a positive effect on postural stability **(Nicola S et al, 2008).**

The trunk is the center of the body, and it plays a postural role in functional movement by preparing the body for the movement of the extremities against gravity. It also plays an active role in smoothing the movement of the center of gravity, and it enables ease of movement into a new posture. Balance is the result of interactions among the visual system, vestibular system, proprioceptive system, musculoskeletal system, and cognitive ability. Balance maintenance is a very important element for safe and independent performance in ordinary life of movements and walking **(Ryerson S et al, 2008).** Stroke patients suffer from balance disability due to abnormalities in the proprioceptive system, sensory system, trunk muscles, and muscles of the limbs. Stroke often causes paralysis on the affected side as soon as it occurs, decreasing the adjustment ability of the trunk. In particular, reduction in the activity of the muscles of the trunk reduces movement of the pelvis, leading to the development of asymmetry of the trunk, and preventing use of strategies protecting against the risk of balance loss. A previous study evaluated the trunk muscles of stroke patients and normal age-matched controls using a handheld dynamometer and found that stroke patients' bilateral lateral flexors were weaker. A study that used an isokinetic dynamometer reported that trunk flexors, extensors, and bilateral rotators were weakened in stroke patients **(Karatas M et al, 2004).**

Stroke patients experience weakened trunk muscles on the unaffected side, as well as the affected side. Therefore, evaluation of the trunk should be made on the affected and unaffected sides. The trunk exercise on a stable support surface with subacute stroke patients and reported that the functions of their trunks improved and observed that exercise on different support surfaces had a positive influence on subacute stroke patients **(Verheyden G et al 2009).** An unstable support surface stimulated the sensory system and the motor system more than a stable support surface, effectively changing postural orientation ability and aiding postural strategies. Until now, clinical evaluation tools for the assessment of stroke patients' trunks have been used.

Thus, in the present study we examined the changes in the trunk balance and postural control using Berg balance scale and Trunk impairment scale to understand the core stability strength exercise and trunk stabilization exercise affects postural control and balance ability. This study also aimed to establish a scientific basis for an effective trunk muscle-training environment for stroke patients.

1.2 NEED OF THE STUDY

Stroke patients have asymmetrical posture due to hemiplegia, which influences balance while in the sitting position. Maintaining balance during sitting is a necessary element in independent performance. The somatosensory system provides the CNS with position and motion information about the body with reference to supporting surfaces. Also somatosensory inputs throughout the body report information about the relationship of body segment to one another and hence maintaining balance. Since stroke subjects often present with somatosensory deficits, the adaptation of regular exercises with the use of surface and vision manipulation to challenge balance could improve the process of somatosensory integration and have a positive effect on postural stability. Therefore trunk stabilization and core stability strength will be the vital part to show the return of balance and postural control.

The recovery of independence following stroke is a complex process requiring the reacquisition of many skills. Since controlling the body's position in space is essential part of functional skills, restoration of balance is a critical part of the recovery of ability after stroke. An important cause of balance impairment in patients with stroke hemiparesis is a deficit of the central integration of somatosensory, visual and vestibular inputs. In normal adult subjects, the visual, vestibular and somatosensory systems are all involved in balance control and make up the system of coordinates on which the body's postural control is based. Stroke patients experience weakened trunk muscles and core muscles on the unaffected side, as well as the affected side. Thus there is a strong need to develop effective and easy trunk stabilization exercise and core stability strength methods in stroke.

The trunk exercise on a stable support surface with subacute stroke patients improve the function of the trunk and observed that exercise on different support surfaces had a positive influence on subcute stroke patients. An unstable support surface stimulated the sensory system and the motor system more than a stable support surface, effectively changing postural orientation ability and aiding postural strategies.

This study is appropriate to establish the effect of adding core stability strength exercise and trunk stabilization exercise to standard conventional rehabilitation in stroke.

1.3. AIM OF THE STUDY

The aim of the study is to compare the effect of conventional Physiotherapy with core stability strength exercise and conventional Physiotherapy with trunk stabilization exercise on recovery of postural control and balance in hemiplegic patients.

1.4. OBJECTIVES OF THE STUDY

- To find out the effects of conventional Physiotherapy with core stability strength exercise on recovery of postural control and balance in hemiplegic patients.
- To find out the effects of conventional Physiotherapy with trunk stabilization exercise on recovery of postural control and balance in patients.
- To compare the effects of conventional Physiotherapy with core stability strength exercise and conventional Physiotherapy with trunk stabilization exercise on recovery of postural control and balance in hemiplegic patients.

1.5. HYPOTHESIS

Null Hypothesis

There was no statistically significant difference between conventional Physiotherapy with core stability strength exercise and conventional Physiotherapy with trunk stabilization exercise on recovery of postural control and balance in hemiplegic patients.

Alternate Hypothesis

There was statistically a significant difference between conventional Physiotherapy with core stability strength exercise and conventional Physiotherapy with trunk stabilization exercise on recovery of postural control and balance in hemiplegic patients.

1.6. OPERATIONAL DEFINITIONS

Hemiplegic Patient:

Patient with weakness of right side of the body due to left cerebrovascular territory infarct.

Trunk stabilization exercise:

Exercises to help stabilize your midsection or trunk are often used as part of a rehabilitation program after stroke. The task-specific movement exercises of the upper and lower trunk in the supine and sitting positions (**Sea Hyun Bae et al, 2013**).

Core stability strength exercise:

The core is the biggest part of our body and plays an important role in the stabilization and movement of body segments. The truncus makes it possible for us to maintain posture and enables the movement of legs or arms, opposing gravity. It also contributes to smooth central movement so that our body easily can be changed to new posture (**Ryerson et al., 2008**).

Berg balance exercise

The Berg Balance Scale (BBS) was developed to measure balance among older people with impairment in balance function by assessing the performance of functional tasks. It is a valid instrument used for evaluation of the effectiveness of interventions and for quantitative descriptions of function in clinical practice and research. The test takes 15–20 minutes and comprises a set of 14 simple balance related tasks, ranging from standing up from a sitting position, to standing on one foot **(Katherine Berg et al, 2012).**

Trunk impairment scale:

This newly developed scale evaluates motor impairment of the trunk after stroke. The TIS scores, on a range from 0 to 23, static and dynamic sitting balance as well as trunk co-ordination (**G Verheyden et al 2004).**

CHAPTER II

REVIEW OF LITERATURE

LITERATURE REGARDING GENERAL ASPECT OF STROKE

Manjari Tripathi et al (2011)

Stroke in young has special significance in developing countries. This is so because some etiologies like cardio embolic infections are more common than in developed countries, and the affection of economically productive group adds further to the overall disease burden. The paper discusses the burden of stroke in young and its implications in a developing country like India along with an approach to identifying different causes that are known to occur in this age group

Nishant K. Mishra et al (2010)

Stroke is a major cause of mortality worldwide and commonly occurs amongst elderly. Indian population is relatively young Indian population≥60 years: 7.5% compared to the west e.g. British population aged ≥65 year, but the stroke in India has already attained epidemic proportions annual incidence of stroke: 13 per 100 000 in 1969-7 and 145 per 100 000 per year

Madhumita Bhattacharjee (2007)

The prevalence rates for completed strokes for North India being 143/1 lakh; for West India at 245/1 lakh; for South it has been 64/1 lakh and for East India 270/1 lakh.

Tapas Kumar et al (2006)

After coronary heart disease and cancer of all types stroke is the third commonest cause of death worldwide.

Susantha Bhatacharia et al (2005)

Average annual incidence rate of stroke in India is 123.5 per 100000 persons. Age specific stroke incidence rate showed increasing rate from fourth up to seventh decade in both sexes. Follow up after one year revealed speech improvement in 47%, residual spasticity in 46% and independency in activities of daily living in 62% of cases. Hospital based information have shown a mortality rate ranging from 24% to 34%.

Anand et al (2001)

The proportion of stroke death increases with age and in the oldest group (>70 years of age) Stroke contributed to 2.4% of all death. Prevalence in India is estimated as 230 per 1000000 populations, around 12% of all stroke occurred in population below 40 years.

Cauraugh James (2000)

Voluntary control is typically impaired after stroke. Movement control of the body on the contra lateral side of brain lesion proceeds through stages of recovery in which sensory and motor function are often reestablished abnormally.

LITERATURE REGARDING RECOVERY OF BALANCE AND POSTURE AFTER STROKE

Peter Langhorne et al (2009)

Improvements in transfer ability or balance were seen with repetitive task training, biofeedback, and training with a moving platform. Physical fitness training, high-intensity therapy usually physiotherapy and repetitive task training improved walking speed. Although the existing evidence is limited by poor trial designs, some treatments do show promise for improving motor recovery, particularly those that have focused on high-intensity and repetitive task-specific practice.

Sarah F. Tyson et al (2007)

They have studied on the relationship between balance, disability, and recovery after stroke: Predictive validity of the Brunel Balance Assessment. To examine the influence of balance disability on function and the recovery of function after stroke and consequently to assess the predictive validity of the Brunel Balance Assessment (BBA). Methods. Cross-sectional study of 102 patients admitted consecutively to 6 National Health Service hospitals with weakness 2 to 4 weeks after their first anterior circulation stroke; 75 of whom completed follow-up assessment at 3 months. The BBA was assessed during admission and compared to the Barthel Index and Rivermead Mobility Index at 3 months. Results*:* Balance disability was the strongest predictor of function (in terms of activities of daily living [ADLs] and mobility disability) in the acute stages. Weakness was also an independent predictor. Recovery of ADLs was independently predicted by balance disability, weakness, age, and premorbid disability, whereas recovery of mobility disability was predicted by balance and age alone. At 3 months, a minority of people with limited sitting balance (0%-22%) and standing balance (25%-50%) recovered independent functional mobility. Most people who could walk initially recovered independent functional mobility (66%-84%), but 16% suffered a decline in their mobility and 44% had enduring limitations in everyday mobility activities. Conclusion*:* Initial balance disability is a strong predictor of function and recovery after stroke. These results demonstrate the predictive validity of the BBA.

Sarah F Tyson et al (2006)

Balance disability after Stroke background and purpose: Balance disability is common after stroke, but there is little detailed information about it. The aims of this study were to investigate the frequency of balance disability; to characterize different levels of disability; and to identify demographics, stroke pathology factors, and impairments associated with balance disability. Subjects. The subjects studied were 75 people with a first-time anterior circulation stroke; 37 subjects were men, the mean age was 71.5 years (SD12.2), and 46 subjects (61%) had left hemiplegia. Methods: Prospective hospital-based cross-sectional surveys were carried out in 2 British National Health Service trusts. The subjects' stroke pathology, demographics, balance disability, function, and neurologic impairments were recorded in a single testing session 2 to 4 weeks after stroke. Results. A total of 83% of the subjects (n62) had a balance disability; of these, 17 (27%) could sit but not stand, 25 (40%) could stand but not step, and 20 (33%) could step and walk but still had limited balance. Subjects with the most severe balance disability had more severe strokes, impairments, and disabilities. Weakness and sensation were associated with balance disability. Subject demographics, stroke pathology, and visuospatial neglect were not associated with balance disability. Discussion and Conclusion. Subjects with the most severe balance disability had the most severe strokes, impairments, and disabilities. Subject demographics, stroke pathology, and visuospatial neglect were not associated with balance disability.

Alexander C.H. Geurts et al (2005)

The finding that brain lesions involving particularly the parieto-temporal junction are associated with poor postural control, suggests that normal sensory integration is critical for balance recovery. Despite a considerable number of intervention studies, no definitive conclusions can be drawn about the best approach to facilitate the natural recovery of standing balance following stroke.

Mirjam de Haart et al (2004)

To identify and interrelate static and dynamic characteristics of the restoration of quiet standing balance in a representative sample of stroke survivors in the Netherlands during their inpatient rehabilitation. **Design** Exploratory study using an inception cohort with findings related to reference values from healthy elderly persons. Thirty-seven inpatients (mean age, 61.6y; mean time poststroke, 10.0wk) with a first hemispheric intracerebral infarction or hematoma who were admitted to retrain standing balance and walking. Center of pressure fluctuations were registered under each foot and in the sagittal and frontal planes separately by using a dual-plate force platform. The first balance measurements took place as soon as patients were able to stand unassisted for at least 30 seconds as well as 2, 4, 8, and, 12 weeks later. Quiet standing was assessed under 4 conditions: with and without a visual midline reference, with the eyes closed, and while performing a concurrent arithmetic task. Results The stroke patients showed excessive postural sway and instability, particularly in the frontal plane, compared with reference values. Frontal plane balance was, however, also most responsive to the effects of balance training and recovery ($P<.001$). The degree of visual dependency for frontal plane balance control showed a significant reduction in time ($P<.02$). Weight-bearing asymmetry, which was most pronounced in patients with disturbed sensibility or ankle clonus, diminished considerably during the first 4 weeks of the follow-up period ($P<.02$). Yet, a substantial degree of weight-bearing asymmetry persisted during the 8 weeks thereafter, and it continued to be aggravated by attentional distraction ($P<.001$). During the same period, static asymmetry (ie, the degree of pes equinovarus loading at the paretic side) and dynamic asymmetry (ie, the extent to which compensatory ankle moments are applied at the nonparetic side) did not show normalization at all, although motor selectivity of the paretic leg improved by 1 stage on the 6-stage Brunnstrom scale ($P<.001$) and the independency level of balance and walking skills improved by 2 points on the 6-point Functional Ambulation Categories (*P*<.001). Conclusions Balance recovery in postacute stroke inpatients is characterized by a reduction in postural sway and instability as well as by a reduction in visual dependency, particularly with regard to frontal plane balance. These restoration characteristics may be important factors underlying the relearning of independent standing and walking abilities. The clear lack of normalization for measures reflecting static and dynamic aspects of postural asymmetry suggests that the functional improvements in balance and gait must be more related to other mechanisms than to the restoration of support functions and equilibrium reactions of the paretic leg.

Susan Niam et al (1999)

Postural sway was calculated in terms of center of pressure (COP) parameters including spectral characteristics. Clinical balance was measured using the Balance Scale. The assessed physical impairments included stages of lower limb motor recovery, ankle proprioception, and passive dorsiflexion range of the involved limb. Results: The Balance Scale was correlated with COP speed ($r = -.57$), COP root mean square speed (r −.50), and COP mean frequency ($r = -.50$) in the anterior-posterior direction only. Moderate to high correlations were found among most of the COP parameters except spectral characteristics. Significant differences in postural sway were found among different stance in eyes-open (p = .00 to .02) and eyes-closed conditions (p= .00 to .04). Subjects with impaired ankle proprioception had significantly increased postural sway and decreased Balance Scale scores when compared with the subjects with intact ankle proprioception. Conclusions: Some of the clinical and laboratory balance assessments were related, indicating that some components of the tests are similar, but some measured different aspects of balance. Postural sway was related to visual condition, stance position, and proprioception.

LITERATURE REGARDING TRUNK STABILZATION EXERCISE FOR STROKE PATIENT

Jihye Jung et al (2015)

Stroke patients have asymmetrical posture due to hemiplegia, which influences balance while in the sitting position. Maintaining balance during sitting is a necessary element in independent performance. This study investigated the effects of trunk stabilization training using visual feedback on an unstable surface to improve balance and trunk stability of individuals with chronic stroke debility. Method: Twenty-six patients after stroke were enrolled and randomly allocated to a training group and a control group. Participants in both groups performed patient-specific therapeutic exercise for 5 days per week, 1 hour per day, for 4 weeks. Participants in the training group received trunk stabilization training using visual feedback while sitting on an unstable surface, in addition to therapeutic exercise (3 times per week, for 20 minutes each session). Outcome measures were trunk control ability using a trunk impairment scale (TIS), the static sitting balance represented as postural sway velocity, and the dynamic sitting balance using a modified functional reach arm test. Results: TIS was significantly greater in the training group than in the control group ($p<.05$). Static sitting balance of the training group was significantly improved only in the mediolateral sway velocity with eyes closed ($p<.05$). Dynamic sitting balance showed significant differences in the comparison between groups ($p<.05$). Conclusion: Trunk stabilization training using visual feedback improved sitting balance and the ability to control the trunk of patients in the sitting position. This training would be an effective way to exercise in order to promote functional activity in the sitting position

Junsang Yoo et al (2014)

They have done the study on the effect of trunk stabilization exercise using an unstable surface on the abdominal muscle structure and balance of stroke patients. This study investigated the effect of unstable surface trunk stabilization exercise on the abdominal muscle structure and balance of stroke patients. [Subjects] The subjects were divided into two groups: an unstable surface trunk stabilization exercise group (n=13), and a stable surface trunk stabilization exercise group (n=11). [Methods] Both groups performed trunk stabilization exercise for 30 minutes, 3 days per week for 6 weeks. Abdominal muscle thickness and the Berg Balance Scale (BBS) were measured at the baseline and after 6 weeks. Results: There was a significant improvement in the internal oblique muscle thickness, transversus abdominis thickness and balance ability of the unstable surface trunk stabilization exercise group. Conclusion: The unstable surface trunk stabilization exercise improved the internal oblique and transversus abdominis muscles and balance ability. These results suggest that unstable surface trunk exercise is useful in the rehabilitation stroke patients.

Park et al (2014)

The purpose of this study was to examine the effects of trunk stabilization exercise using a saing on the balance ability of patients with hemiplegia. Subjects: Forty patients with hemiplegia resulting from stroke were divided into a sling exercise group (SEG, n=20) and a mat exercise group (MEG, n=20). Methods: The SEG conducted the trunk stabilization exercise using a sling, and the MEG performed the trunk stabilization exercise on a mat. Results: The balance ability of both groups significantly improved. Although there were no significant differences between the groups, the SEG showed a greater reduction in the sway area (SA) and the sway length (SL) of the center of the pressure compared to the MEG. Conclusion: We recommend trunk stabilization exercise using a sling as a clinical intervention to improve the balance ability of patients with hemiplegia.

Sea Hyun Bae et al (2013)

They have done a study on “Effects of Trunk Stabilization Exercises on Different Support Surfaces on the Cross-sectional Area of the Trunk Muscles and Balance Ability”. The purpose of this study was to examine the effects on stroke patients of trunk stabilization exercise on different support surfaces. Subjects and Methods: Sixteen stroke patients with onset of stroke six months earlier or longer were randomly and equally assigned to group I (exercise performed on a stable support surface) and group II (exercise performed on an unstable support surface). The two groups conducted the trunk stabilization exercises on the respective support surfaces, in addition to existing rehabilitation exercises five times per week for 12 weeks. Changes in the cross-sectional area (CSA) of the muscles were examined using computed tomography (CT), and changes in the balance ability were assessed using a measuring system and the trunk impairment scale (TIS). Results: In group I, there was a significant increase in the CSA of the mulifidus muscle on the side contralateral to the brain lesion and in the paravertebral and multifidus muscles on the side ipsilateral to the brain lesion. In group II, there was a significant increase in the CSA of the paravertebral and multifidus muscles on the side contralateral to the brain lesion and on the side ipsilateral to the brain lesion. In terms of changes in balance ability, the sway path (SP) and TIS significantly improved in group I, and the SP, sway area (SA), and TIS significantly improved in group II . Conclusion: Exercise on the unstable support surface enhanced the size of the cross-sectional area of the trunk muscles and balance ability significantly more than exercise on the stable support surface.

Karthikbabu et al (2011)

They have studied on the role of trunk rehabilitation on trunk control, balance and gait in patients with chronic stroke. Purpose: although proximal stability of the trunk is a prerequisite for balance and gait, to determine the role of trunk rehabilitation on trunk control, balance and gait in patients with chronic stroke is yet unknown. Method: fifteen subjects (post-stroke duration (3.53 ± 2.98) years) who had the ability to walk 10 meters independently with or without a walk-ing aid; scoring ≤ 21 on Trunk Impairment Scale (TIS), participated in a selective trunk muscle exercise regime, con-sisting of 45 minutes training per day, four days a week, and for four weeks duration in an outpatient stroke rehabilita-tion centre. Results: the overall effect size index for trunk rehabilitation was 1.07. This study showed large effect size index for Trunk Impairment Scale (1.75), Berg Balance Scale (1.65) than for gait variables (0.65). After trunk rehabili-tation, there was a significant improvement for gait speed ($p = 0.015$), cadence ($p = 0.001$) and gait symmetry ($p = 0.019$) in patients with chronic stroke. In addition, all the spatial gait parameters had a significant change post-in-tervention. There was no significant change in temporal gait parameters with the exception of affected single limb sup-port time. The level of significance was set at $p < 0.05$. Conclusion: the exercises consisted of selective trunk movement of the upper and the lower part of trunk had shown larger effect size index for trunk control and balance than for gait in patients with chronic stroke. Future randomized controlled studies incorporating large sample size would provide in-sight into the effectiveness and clinical relevance of this intervention.

LITERATURE REGARDING CORE STABILITY STRENGTH EXERCISE FOR STROKE PATIENT

Rosa Cabanas Valdés et al (2015)

They have studied on the effect of additional core stability exercises on improving dynamic sitting balance and trunk control for sub acute stroke patients: A randomized controlled trial. To examine the effect of core stability exercises on trunk control, dynamic sitting and standing balance, gait, and activities of daily living in subacute stroke patients. A randomized controlled trial. Setting: Inpatient rehabilitation hospital in two centres. Subjects: Eighty patients (mean of 23.25 (±16.7) days post-stroke) were randomly assigned to an experimental group and a control group. Interventions: Both groups underwent conventional therapy for five days/week for five weeks and the experimental group performed core stability exercises for 15 min/day. The patients were assessed before and after intervention. Main measures: The Trunk Impairment Scale (Spanish-Version) and Function in Sitting Test were used to measure the primary outcome of dynamic sitting balance. Secondary outcome measures were standing balance and gait as evaluated via Berg Balance Scale, Tinetti Test, Brunel Balance Assessment, Postural Assessment Scale for Stroke (Spanish-Version), and activities of daily living using Barthel Index. Results: The experimental group showed statistically significant differences for all of the total scale scores ($P<0.05$), except for the sitting section of the Brunel Balance Assessment. The mean (SD) difference between groups in Trunk Impairment Scale total score was 3.40 (±4.12) points, and its subscale dynamic sitting balance was 2.28 (±3.29). The Berg Balance Scale was 14.54 (±18.19) points, and the Barthel Index was 13.17 (±25.27) points. Collectively, these results were in favour of the experimental group. Conclusions: Core stability exercises in addition to conventional therapy improves trunk control, dynamic sitting balance, standing balance, gait and activities of daily living in subacute post-stroke patients.

Eun-Jung Chung et al (2013)

They have studied on the effects of core stabilization exercise on dynamic balance and gait function in Stroke patients. The purpose of this study was to determine the effects of core stabilization exercise on dynamic balance and gait function in stroke patients. Subjects: The subjects were 16 stroke patients, who were randomly divided into two groups: a core stabilization exercise group of eight subjects and control group of eight subjects. Methods:

Subjects in both groups received general training five times per week. Subjects in the core stabilization exercise group practiced an additional core stabilization exercise program, which was performed for 30 minutes, three times per week, during a period of four weeks. All subjects were evaluated for dynamic balance (Timed Up and Go test, TUG) and gait parameters (velocity, cadence, step length, and stride length). Results: Following intervention, the core exercise group showed a significant change in TUG, velocity, and cadence. The only significant difference observed between the core group and control group was in velocity. Conclusion: The results of this study suggest the feasibility and suitability of core stabilization exercise for stroke patients.

Seong-Hun Yu et al (2013)

They have studied on the effects of core stability strength exercise on muscle activity and trunk impairment scale in stroke patients. The purpose of this study was to examine the effects of core stability-en-hancing exercises on the lower trunk and muscle activity of stroke pa-tients. The control group (n= 10) underwent standard exercise therapy, while the experiment group (n=10) underwent both the core stability-en-hancing exercise and standard exercise therapy simultaneously. The standard exercise therapy applied to the two groups included weight bearing and weight shifts and joint movements to improve flexibility and the range of motion. The core stability-enhancing exercise was per-formed 5 times a week for 30 min over a period of 4 weeks in the room where the patients were treated. For all 20 subject, the items measured before the exercise were measured after the therapeutic intervention, and changes in muscle activity of the lower trunk were evaluated. The activity and stability of the core muscles were measured using surface electromyography and the trunk impairment scale (TIS). The mean TIS score and muscle activity of the lower trunk increased in the experi-ment group significantly after performing the core stability-enhancing ex-ercise ($P<0.05$). The results of this study show that the core stability-en-hancing exercise is effective in improving muscle activity of the lower trunk, which is affected by hemiplegia.

LITERATURE REGARDING CONVENTIONAL PHYSIOTHERAPY FOR STROKE PATIENT

Dundar U et al (2014)

They have studied on a comparative study of conventional physiotherapy versus robotic training combined with physiotherapy in patients with stroke. There has been a growing interest in the use of robotic therapy to improve walking ability in individuals following stroke. OBJECTIVES: The aim of this retrospective study was to compare conventional physiotherapy (CP) with robotic training (RT) combined with CP and to measure the effects on gait, balance, functional status, cognitive function, and quality of life in patient with stroke. METHODS: We retrospectively identified 107 cases of new cerebral stroke. They were allocated into 2 groups. In the RT group (n = 36), patients received RT (Lokomat; 2 times per week) combined with CP (3 times per week) for at least 30 sessions. In the CP group (n = 71), patients received a program at least 30 sessions, 5 times per week. The evaluation parameters included modified Ashworth Spasticity Scale (MASS), Brunnstrom Recovery Scale (BRS), Functional Independence Measure (FIM), Functional Ambulation Categories (FAC), Berg Balance Scale (BBS), Mini-Mental State Examination (MMSE), and Short Form-36 (SF-36) Health Survey. RESULTS: Posttreatment results showed significant improvements for all parameters (except lower extremity MASS scores) in both groups. However, when we compared the percentage changes of parameters at discharge relative to pretreatment values, improvements in FIM, MMSE, and all subparts of SF-36 were better in the RT group ($P < .05$). Comparison of posttreatment evaluation parameters for categorical variables showed that the lower extremity categories in the BRS were significantly better in the RT group than the CP group ($P < .05$). CONCLUSION: RT combined with CP produced better improvement in FIM, MMSE, BRS lower extremity categories, and all subparts of SF-36 of the patients with subacute and chronic stroke (up to 1 year) than the CP program.

Askim T et al (2013)

They have studied on Physiotherapy after stroke: to what extent is task-oriented practice a part of conventional treatment after hospital discharge? Research has shown that motor training after stroke should be task-oriented. It is still unknown whether the task-oriented approach is implemented into clinical practice. The purpose of the present study was to survey to which extent task-specific training was a part of conventional physiotherapy practice given to stroke patients after discharge from hospital. This cross-sectional survey was a sub-study of a randomized controlled trial. Physiotherapists treating patients included in the trial were asked to register their choice of treatment according to 11 predefined activity categories during the second week after discharge from hospital. Nineteen physiotherapists treating 46 patients suffering from mild-to-moderate stroke were included. The activities chosen in most patients were sit-to-stand (60.9%), balance in standing position (65.2%), walking on even ground (78.3%), and stair climbing (56.5%). Only two patients (4.3%) practiced transfers or balance related to activities of daily living (ADL), such as washing, dressing, and toileting. This study shows that conventional physiotherapy practice for a selected group of Norwegian stroke patients was mainly based on a task-oriented approach, although with very little emphasis on training in relation to ADL. Future research is needed to ensure that evidence-based treatment is given to all stroke patients.

Ahmet Inanır et al (2013)

They have studied on Effectiveness of Conventional Rehabilitation Therapy on Postural Stability and Clinic in Stroke Patients with Hemiplegia. Objective: The aim of the present study was to determine the effectiviness of conventional rehabilitation in patients with stroke on static and dynamic balance as well as clinical assessment. Methods: Twelve patients with stroke, 7 (58.33%) of them being male and 5 (41.66%) female, ranging from 51 to 75 in age who were treated in Physical Medicine and Rehabilitation clinic were involved in this study. The patients were treated with conventional rehabilitation. All individuals were evaluated using balance tests before (Group 1) and after (Group 2) the treatment. Balance level and postural control has been assessed through Berg Balance Scale (BBS), Trunk Control Test (TCT) and Biodex Stability System (BSS), motor level through BMİE, ambulation state through Functional Ambulatory Scale (FAS) and functional state in daily activities through Functional Independence Measure (FIM). Results: The mean age of the study population was 65,83±4,38 years, the average Body

Mas Index (BMI) was 30,55±6,94. In the evaluations according to FIM, FAS, TCT and BBS differences between the mean of patients before and after the rehabilitation were significantly higher for the post-treatment (p=0.001, p=0.001, p=0.001 and p=0.001, respectively). In the evaluations according to Overall Stability Index (OSI), Antero-Posterior Stability Index (APSI) and Medio-Lateral Stability Index (MLSI) differences between the mean of patients before and after the rehabilitation were significantly higher for the pre-treatment. Conclusion: It can be stated that this approach is effective and useful in restoring static and dynamic balance as well as in obtaining an effective improvement in the treatment of patients with stroke through conventional treatment.

Ruth Ann Geiger et al (2001)

They have studied on Balance and Mobility Following Stroke: Effects of Physical Therapy Interventions With and Without Biofeedback/Forceplate Training. Visual biofeedback/forceplate systems are often used for treatment of balance disorders. In this study, the researchers investigated whether the addition of visual biofeedback/forceplate training could enhance the effects of other physical therapy interventions on balance and mobility following stroke. Subjects. The study included a sample of convenience of 13 outpatients with hemiplegia who ranged in age from 30 to 77 years ($\bar{X}$=60.4, SD=15.4) and were 15 to 538 days poststroke. Methods. Subjects were assigned randomly to either an experimental group or a control group when the study began, and their cognitive and visual-perceptual skills were tested by a psychologist. Subjects were also assessed using the Berg Balance Scale and the Timed "Up & Go" Test before and after 4 weeks of physical therapy. Both groups received physical therapy interventions designed to improve balance and mobility 2 to 3 times per week. The experimental group trained on the NeuroCom Balance Master for 15 minutes of each 50-minute treatment session. The control group received other physical therapy for 50 minutes. Results: Following intervention, both groups scored higher on the Berg Balance Scale and required less time to perform the Timed "Up & Go" Test. These improvements corresponded to increased independence of balance and mobility in the study population. However, a comparison of mean changes revealed no differences between groups. Discussion and Conclusion: Although both groups demonstrated improvement following 4 weeks of physical therapy interventions, no additional effects were found in the group that received visual biofeedback/forceplate training combined with other physical therapy.

LITERATURE REGARDING BERG BALANCE SCALE SCORE FOR STROKE PATIENT

Lisa Blum et al (2008)

They have studied on usefulness of the Berg Balance Scale in stroke rehabilitation. In a recent study of 655 physical therapists working with a stroke population, the Berg Balance Scale (BBS) was identified as the most commonly used assessment tool across the continuum of stroke rehabilitation. Given the widespread popularity of the BBS, it is important to critically appraise the BBS for its use with a stroke population. Objective: The purposes of this study were to conduct a systematic review of the psychometric properties of the BBS specific to stroke and to identify strengths and weaknesses in its usefulness for stroke rehabilitation. Results: Twenty-one studies examining the psychometric properties of the BBS with a stroke population were retrieved. Internal consistency was excellent (Cronbach alpha=.92–.98) as was interrater reliability (intraclass correlation coefficients [ICCs]=.95–.98), intrarater reliability (ICC=.97), and test-retest reliability (ICC=.98). Sixteen studies focused on validity and generally found excellent correlations with the Barthel Index, the Postural Assessment Scale for Stroke Patients, Functional Reach Test, the balance subscale of Fugl-Meyer Assessment, the Functional Independence Measure, the Rivermead Mobility Index (except for weight shift and step-up items), and gait speed. Berg Balance Scale scores predicted length of stay, discharge destination, motor ability at 180 days poststroke, and disability level at 90 days, but these scores were not predictive of falls. Eight studies focused on responsiveness; all reported moderate to excellent sensitivity. Three studies found floor or ceiling effects. Discussion and Conclusion: The BBS is a psychometrically sound measure of balance impairment for use in poststroke assessment. Given the floor and ceiling effects, clinicians may want to use the BBS in conjunction with other balance measures.

Chia-Yeh Chou et al (2006)

They have studied on developing a short Form of the Berg Balance Scale for people with Stroke. To improve the utility of the Berg Balance Scale (BBS), the aim of this study was to develop a short form of the BBS (SFBBS) that was psychometrically similar (including test reliability, validity, and responsiveness) to the original BBS for people with stroke. Subjects and Methods: A total of 226 subjects with stroke participated in this prospective study at 14 days after their stroke; 167 of these subjects also were examined at 90 days after their stroke. The BBS, Barthel Index, and Fugl-Meyer Motor Test were administered at these 2 time points. By reducing the number of tested items by more than half the number of items in the original BBS (ie, making 4-, 5-, 6-, and 7-item tests) and simplifying the scoring system of the original BBS (ie, collapsing the 5-level scale into a 3-level scale [BBS-3P]), we generated a total of 8 SFBBSs. Results: The distributions of scores for all 8 SFBBSs were acceptable but featured notable floor effects. The 4-item BBS, 5-item BBS, 5-item BBS-3P, and 7-item BBS-3P demonstrated good reliability. The subjects' scores on the 6-item BBS, 6-item BBS-3P, 7-item BBS, and 7-item BBS-3P showed excellent agreement with those on the original BBS. The 6-item BBS-3P and 7-item BBS-3P exhibited great responsiveness. Only the 7-item BBS-3P demonstrated both satisfactory and psychometric properties similar to those of the original BBS. Discussion and Conclusion: The 7-item BBS-3P was found to be psychometrically similar to the original BBS. The 7-item BBS-3P, compared with the original BBS, is simpler and faster to complete in either a clinical or a research setting and is recommended.

Teresa M Steffen et al (2002)

They have studied on age and gender-related test performance in community-dwelling elderly people: Six-Minute Walk Test, Berg Balance Scale, Timed Up & Go Test, and Gait Speeds. The interpretation of patient scores on clinical tests of physical mobility is limited by a lack of data describing the range of performance among people without disabilities. The purpose of this study was to provide data for 4 common clinical tests in a sample of community-dwelling older adults. Subjects: Ninety-six community-dwelling elderly people (61–89 years of age) with independent functioning performed 4 clinical tests. Methods: Data were collected on the Six-Minute Walk Test (6MW), Berg Balance Scale (BBS), and Timed Up & Go Test (TUG) and during comfortable- and fast-speed walking (CGS and FGS). Intraclass correlation coefficients

(ICCs) were used to determine the test-retest reliability for the 6MW, TUG, CGS, and FGS measurements. Data were analyzed by gender and age (60–69, 70–79, and 80–89 years) cohorts, similar to previous studies. Means, standard deviations, and 95% confidence intervals for each measurement were calculated for each cohort. Results: The 6MW, TUG, CGS, and FGS measurements showed high test-retest reliability (ICC [2,1]=.95–.97). Mean test scores showed a trend of age-related declines for the 6MW, BBS, TUG, CGS, and FGS for both male and female subjects. Discussion and Conclusion: Preliminary descriptive data suggest that physical therapists should use age-related data when interpreting patient data obtained for the 6MW, BBS, TUG, CGS and FGS. Further data on these clinical tests with larger sample sizes are needed to serve as a reference for patient comparisons.

Ted J Stevenson et al (2001)

He has done a study on the Berg Balance Scale (BBS) was designed to help determine change in functional standing balance over time. The purpose of this paper was to estimate the minimum detectable change score (MDC) using the standard error of measure (SEM), thereby providing a means to decide if genuine change had occurred. Calculation of the agreement regarding the presence of change as determined by the MDC and clinicians' perceptions was performed to give an indication of the validity of this criterion value. Forty-eight subjects who were receiving inpatient rehabilitation after stroke were assessed on consecutive days by two raters using the BBS. The MDC analysis suggests that a change of ±6 BBS points is necessary to be 90% confident of genuine change. Only 25/45 subjects showed agreement between the statistically derived presence of change and clinicians' perceptions of change. The lack of agreement may relate to the validity of the SEM/MDC methodology to determine the criterion BBS value, the heterogeneity of the subjects, or the use of clinician gestalt impressions of change.

LITERATURE REGARDING TRUNK IMPAIREMENT SCALE SCORE FOR STROKE PATIENT

G Verheyden et al (2004)

They have studied on the Trunk Impairment Scale: a new tool to measure motor impairment of the trunk after stroke. To examine the clinimetric characteristics of the Trunk

Impairment Scale (TIS). This newly developed scale evaluates motor impairment of the trunk after stroke. The TIS scores, on a range from 0 to 23, static and dynamic sitting balance as well as trunk co-ordination. It also aims to score the quality of trunk movement and to be a guide for treatment. Design: Two physiotherapists observed each patient simultaneously, but scored independently. Each patient was re-examined by one of the therapists. Subjects: Twenty-eight patients in a rehabilitation setting. Results: Kappa and weighted kappa values for item per item reliability ranged for all but two, from 0.62 to 1. All percentages of agreement exceeded 81%. Intraclass correlations (ICC) for the summed scores of the different subscales were between 0.85 and 0.99. Test–retest and interobserver reliability for the TIS total score (ICC) was 0.96 and 0.99, respectively. The 95% limits of agreement for the test–retest and interexaminer measurement error were -2.90, 3.68 and -1.84, 1.84, respectively. Cronbach alpha coefficients for internal consistency ranged from 0.65 to 0.89. Content validity was defined. Spearman rank correlations with the Barthel Index (r5=0.86) and the Trunk Control Test (r5=0.83) was used to examine construct and concurrent validity, respectively. Conclusions: Analysis of different clinimetric parameters support the use of the TIS in both clinical use and future stroke research. Guidelines for treatment and level of quality of trunk activity can be derived from the assessment.

Verheyden G et al (2007)

They have studied on clinical tools to measure trunk performance after stroke: a systematic review of the literature. To give a systematic review of clinical measurement scales used to assess trunk performance after stroke. All articles were selected which reported or included a clinical measure of trunk performance used in an adult stroke population. Reference lists were searched as secondary.sources of articles. Result: A total of 458 articles resulted from the database search. Thirty-two articles were eligible for inclusion. Earlier studies mentioned ordinal single items or a combination of items which are part of a larger scale used to assess sitting balance as a derived measure of trunk performance. Three clinical tools were available which specifically evaluated trunk performance after stroke; the Trunk Control Test and two Trunk Impairment Scales. Conclusion: Ordinal single items or subscales of existing larger scales lack a systematic evaluation of psychometric characteristics. oth Trunk Impairment Scales have been extensively examined. A comparative study assessing psychometric properties of the Trunk

Control Test and two Trunk Impairment Scales could determine which should be the measure of choice when assessing trunk performance after stroke.

G Verheyden et al (2005)

They have studied on discriminant ability of the Trunk Impairment Scale: A comparison between stroke patients and healthy individuals. The Trunk Impairment Scale (TIS) is a standardized scale to evaluate the trunk function in stroke patients. It was the aim of this study to determine the discriminant ability of the TIS by comparing stroke patients with healthy individuals. Further, the variables that had an influence on obtaining a high score on the TIS in healthy subjects were examined. Method: Forty stroke patients and 40 age- and sex-matched healthy individuals were included in the study. TIS scores from the stroke patients and healthy individuals were compared using the Wilcoxon ranked sum test. Results Sub-scale and total TIS scores showed significant differences between stroke patients and healthy individuals ($P<0.0001$). Univariate analysis and logistic regression analysis further revealed that younger persons, women and people who are more active in daily life have a higher chance of obtaining a high score on the TIS. Conclusions: The TIS discriminates between stroke patients and healthy individuals. A submaximal score on the TIS was found in 45% of the healthy subjects suggesting that a lower score on the TIS still indicates normal trunk function and full participation in daily life.

CHAPTER III

METHODOLOGY

A total of 30 ambulatory hemiplegic stroke patients were recruited into this study and randomly assigned into two groups, the control group and trained group. Visual feedback core stability strength exercise and trunk stabilization exercise were used in the trained group. Berg balance scale score and Trunk impairment scale scores of each patient were recorded. Data were collected before training and 3 months after completing the training program.

3.1 Study Design:

Quasi Experimental study design

3.2 Study Setting:

The study was conducted at outpatient Department, PPG College of Physiotherapy, and Ashwin Hospital, Coimbatore under the supervision of concerned authority.

3.3 Sample Size:

A total number of 30 subjects were selected and assigned into experimental group 1 and experimental group 2 of 15 each.

3.4 Sampling Method:

Non probability convenient sampling was used for selecting the sample from the population. Thirty patients were selected by non probability convenient sampling was assigned into experimental 1 and experimental 2 group of 15 each.

Group A – Receives conventional physiotherapy with core stability strength exercise (Experimental group - I) Group B – Receives conventional Physiotherapy with trunk stabilization exercise (Experimental group -II)

3.5 Selection Criteria:

3.5.1 Inclusion criteria

- 45-60 years of age
- 1-3 months post stroke patients
- Motor Assessment Scale sitting score of 3
- Brunnstorm recovery stage score 4
- Both males and females
- No visual deficits
- No sensory deficits

3.5.2 Exclusion criteria:

(A) Neurological

- Any cognitive deficits
- Any other neurological deficits as multiple sclerosis, Parkinson's disease etc.
- Any musculoskeletal disorder like osteoarthritis, ligament injury etc
- Patient undergoing any other balance training protocol simultaneously
- Non-cooperative patients
- Neoplasm-primary and secondary
- Degenerative and demyelinating disease
- Traumatic head injury
- Seizures
- Peripheral neuropathy
- Movement disorders
- Aphasia
- Apraxia
- Brain tumors

(B) Orthopaedic problems

- Recent fractures and soft tissue injuries

- Congenital and acquired deformities
- Arthritis of any causes
- Other orthopedic problems
- Recent surgeries

(C) Cardio-Thoracic problems

- Acute MI
- Recent surgeries
- COPD
- Severe hypertension

(D) Other problems

- Vasomotor impairments of upper limb
- Postural hypotension
- Visually and audibly challenged persons
- Uncontrolled diabetes and hypertension
- Any recent medical and surgical problems
- Psychiatric and uncooperative patient

3.6 Study Duration:

- Duration of the study was 3 months

3.7 Materials:

- Consent Form
- General Case Sheet Record.
- Data Collection Sheet
- Brunnstrom's recovery stage chart
- Assessment Chart
- Five minutes Hearing Test
- Mini-Mental State Examination

3.8 Parameter:

Berg balance scale score **(BBS)** and Trunk impairment scale score **(TIS)**

3.9 Procedure:

Prior sanction was obtained from the authorities for conducting the study. The patients were taken for primary evaluation and those who satisfied the inclusion criteria were selected for the study. Filled in consent form from the patient or the relatives of the each patient were taken. .On the first day before the first treatment session all patients in the study were assessed using Berg balance scale and Trunk impairment scale. The patients were checked for sensory and vasomotor impairments. Cognitive 13 level, language and speech were assessed with the Mini- Mental state examination chart. Any auditory problem was ruled out with Five-Minute hearing test.

Both groups received standard conventional physiotherapy treatment for 30 minutes. Group A receives Core stability strength exercise and Trunk stabilization exercise for 45 minutes in addition to conventional treatment. Post test assessment was taken using Berg balance scale and Trunk impairment scale.

3.10 Technique:

CONVENTIONAL PHYSIOTHERAPY

Conventional physiotherapy is received for 30 minutes by both groups.

A) ACTIVE ASSISTED RANGE OF MOTION EXERCISE

a. Upper limb (5 times each movement)

- Shoulder girdle –protraction,retraction,elevation,depression
- Glenohumeral joint- flexion,extension,adduction,abduction,external rotation and internal rotation
- Elbow joint- flexion extension
- Radioulnar joint- Supination ,pronation
- Wrist joint- flexion,extension,radial deviation,ulnar deviation
- Metacarpophalangeal joint- flexion and extension
- Interphalangeal joint- flexion,extension

b. Lower limb (5 times each movement)

- Hip joint- flexion ,extension, abduction, adduction
- Knee joint - flexion ,extension
- Anlkle joint- dorsiflexion, plantar flexion
- Subtalar joint- Inversion, eversion
- Metatarsophalangeal joint – flexion, extension
- Interphalangeal joint- flexion, extension

B) FUNCTIONAL MOBILITY EXERCISES (5 REPETITIONS EACH)

a) ACTIVITIES IN SITTING

- Weight transference from side to side with feet supported
- Moving in sitting
- Weight transference through the arm sideways and arms behind
- Sitting to standing without support

b) ACTIVITIES IN STANDING

- Weight bearing on the affected leg –place the sound leg on a step in front and then to side, making a figure of eight with the sound leg
- Stepping up with the affected leg on the step and then lower the sound leg further down to the floor.
- Stepping up with the affected leg on the step ,step over and up.
- Walking in a parallel bar in front of the mirror
- Walking sideways in the parallel bar
- Walking unaided
- Stair climbing exercises –Five steps with assistance and support.

C) GAIT TRAINING

- Walking in the parallel bar
- Walking sideways in the parallel bar
- Walking without support
- Stair climbing 4 to 5 steps

D) BALANCE TRAINING

- Standing wide to narrow to tandem position
- Standing on one leg
- Upper extremity movements include single UE raises to bilateral raises (symmetrical and

Each experimental group's exercise method

The group I conducted the Core stability strength exercise, in addition to existing rehabilitation exercises five times per week for 12 weeks. The group II conducted the trunk stabilization exercises on the respective support surfaces, in addition to existing rehabilitation exercises five times per week for 12 weeks. Both groups conducted warming up exercises for 5 minutes, the main exercise for 20 minutes, and cooling-down exercises for 5 minutes, for a total of 30 minutes, in addition to existing rehabilitation treatment five times per week for 12 weeks.

Table -1 Experimental group's exercise method

Group-I Core stability strength exercise	Group-II Trunk stabilization exercise
<u>LYING POSITION:</u> The core stability-enhancing program was performed as follows. Patient was lying rightly on an adjustable treatment table. After extending the hip and knee joints, both the hip and knees were supported by a pillow to maintain this posture. Next, the blade bone was retracted such that the shoulder girdle is positioned in abduction, and a towel was placed below the blade bone to prevent the pectoralis major from performing a compensatory action via relaxing both shoulders. Another preparatory step is enhancing the	**<u>SUPINE POSTION</u>** Pelvic bridge (raising the pelvis with both legs on the physio ball) Unilateral bridge (raising and maintaining the foot on the non-paretic side in a pelvic bridge position from the ball) Upper trunk flexion rotation (placing the trunk on the physio ball, bending the knees, placing the soles of the feet on the ground and grabbing an object on the hip joint on the opposite side) Lower trunk flexion rotation (bringing the pelvis diagonally to the shoulder in a pelvic bridge posture)

stability of the neck region. For this, the head was lifted and held in this position by flexing the abdominal region. At the same time, the neck was pulled down to prevent the column from bending. Maintaining this posture, the upper part of the back was lifted as much as possible and twisted slightly in a diagonal direction so that the right hand can face the left knee. This position was maintained for a moment before lowering the back. At this moment, the left arm was aligned, and therapists lead them in right direction and provide minimum help for patients who have difficulty in doing it due to weak abdominal muscle in order that they can control it by themselves. This exercise was repeated; only this time the left hand faced the right knee for enhancing the abdominal muscles on the left. While maintaining this position, the jaw should be on the middle of the chest, and care should be taken that the jaw is not twisted. All these exercises enhanced the stability of core muscles.	**SITTING POSITION:** Lower trunk flexion extension (performing anteflexion and retroflexion on the physio ball) Upper trunk lateral flexion (moving the elbow down to the ball from the shoulder girdle) Lower trunk lateral flexion (raising the pelvis from the ball in the direction of the ribcage from the pelvic girdle) Upper trunk rotation (moving the shoulders forward and backward) Lower trunk rotation (moving the knees forward and backward) Weight shifting (moving the ball forward and touching the tops of the feet and moving the ball backward to a maximum level) Forward reach (forward flexing the trunk and grabbing an object at the height of the shoulders) Lateral reach (grabbing an object at the height of the shoulders by elongating the trunk where the weight is loaded and shortening the opposite trunk)

3.11 Statistical Tool:

The collected data were subjected to statistical analysis using dependent and independent “t” test to find out the research effectiveness.

Dependent “t” Test

The dependent “t” test was used to compare the pre and post test value of MAS and Wrist ROM in Group A and Group B subjects.

Formula: Dependent “t” test

$$S = \frac{\sqrt{\sum d^2 \, (\sum d/n)^2}}{n-1}$$

$$t = \frac{\bar{D}}{s_d/\sqrt{n}}$$

$$s_d = \sqrt{s_1{}^2 + s_2{}^2 - 2r_{12}s_1s_2}$$

d = Difference between the pre Test Vs post Test

d = Mean difference

n = Total number of subjects

s = Standard deviation

Independent “t” test

Independent “t” test was used to compare the mean difference between Group A and B subjects.

Formula: Independent “t” test

$$s_{X_1X_2} = \sqrt{\frac{(n_1-1)s_{X_1}^2 + (n_2-1)s_{X_2}^2}{n_1+n_2-2}}.$$

$$t = \frac{\bar{X}_1 - \bar{X}_2}{s_{X_1X_2} \cdot \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

$n1$ = Total number of subject in Group – A

$n2$ = Total number subject in Group – B

$x1$ = Difference between Pre test Vs post test of Group A

$x1$ = Mean difference between pre Test Vs post test of Group A

$x2$ = Difference between pre test Vs post Group – B

$x2$ = Mean difference between Pre test Vs post test of Group - B

CHAPTER IV

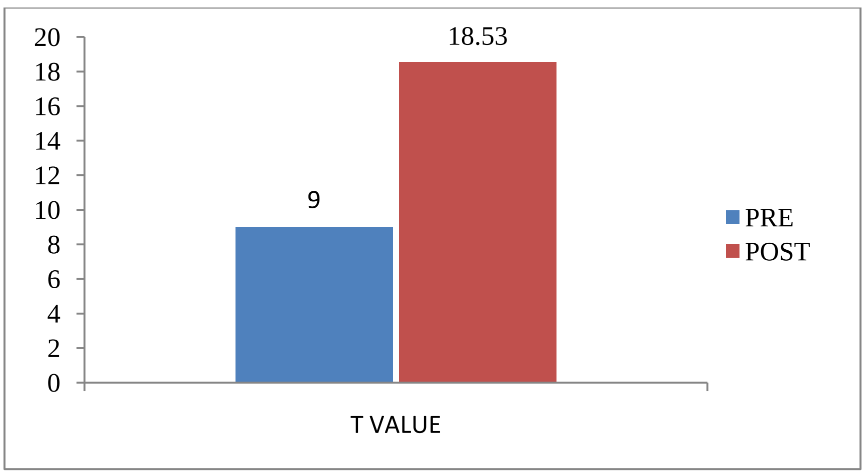
DATA ANALYSIS AND RESULT

4.1 DATA ANALYSIS

Table II - Statistical result of Trunk impairment scale Dependent‘t’ test

Variable	Pair	Group	Pair Difference		T Value	Df	Sig
			Mean	Std. Dev.			
Trunk impairment scale	Pre	Exp – 1	9.0000	2.10442	16.564	14	.000
	Post	Exp – 2	18.5333	1.64172	43.722		

Graph I - Statistical Result of Trunk impairment scale Dependent ‘T’ Test



A) Comparing the pretest and post test values of experimental group – 1 (Core stability strength exercise)

The mean pretest Trunk impairment scale (TIS) score of Group – 1 experimental is 8.7333, and post test mean score of Group – 1 experimental is 9.8000. Calculated “t” value for TIS is 16.564 which is greater than table value at .01 level of significance showing that there is significant difference between two value. This shows the efficacy of Core stability strength exercise along with conventional therapy.

B) Comparing the pretest and post test values of experimental group - 2 (Trunk Stabilization exercise)

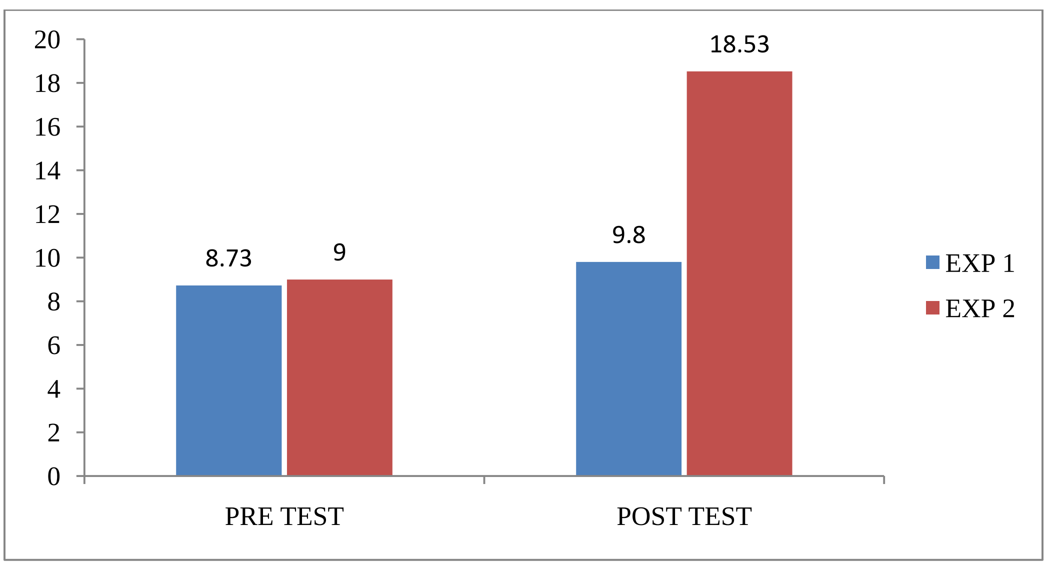
The mean pretest TIS score of experimental group – 2 is 9.0000 and the mean post test TIS score is 18.5333. Calculated "t" value is 43.722 which is greater than the table value, at .01 level of significance, showing that there is significant difference between the two values. This shows the efficacy of Trunk stabilization exercise in improving postural control and balance of the hemiplegic patients.

Analysis of results Using Independent "t" test – Trunk impairment scale

Table III - Statistical result of Trunk impairment scale Independent "t"test

Group	Pre Test			Post Test		
	Mean	SD	Independent T	Mean	SD	Independent T
Exp 1	8.7333	2.34419	0.328	9.8000	2.80815	10.398*
Exp 2	9.0000	2.10442		18.5333	1.64172	

Graph II - Statistical Result of Pre & Post Test Trunk impairment scale – Both Groups



A) Comparing pre test TIS scores of experimental group -1 and experimental -2

Mean pre test TIS score of experimental group 1 is 8.7333 and that for experimental group 2 is 9.0000. Calculated “t” value 0.328 is lesser than that of table value at .01 level of significance showing that there is no significant difference between two groups. We can conclude that both the groups are homogenous.

B) Comparing post test TIS scores of experimental group 1 and experimental group 2

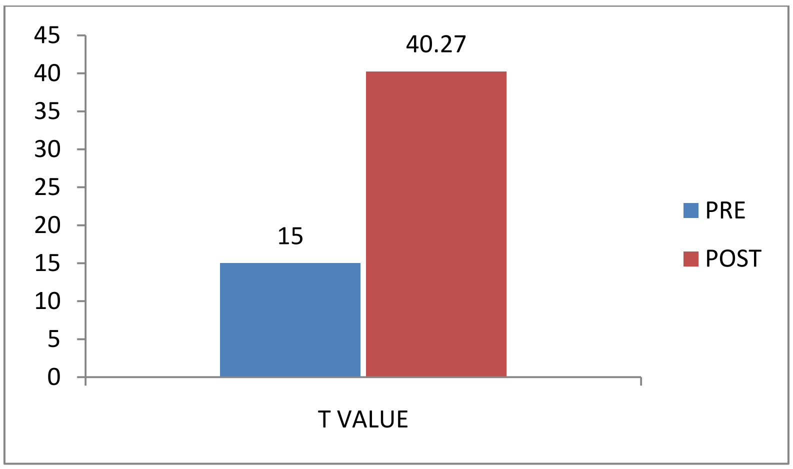
Mean post test TIS score of group - 1 (experimental) is 9.8000 and that for group-2 (experimental) is 18.5333. Calculated “t” value is 10.398 greater than that of table value at .01 level of significance, showing that there is significant difference between two groups. From statistical analysis TIS score significantly improved in experimental group - 2 when compared with that of experimental group 1 (Core stability strength exercise). Hence we can conclude that there is significant improvement in Trunk stabilization exercise in improving postural control and balance of the hemiplegic patients.

Analysis of results Using Dependent "t" test – Berg balance scale

Table IV - Statistical result of Berg balance scale Dependent "t" test

Variable	Pair	Group	Pair Difference		T Value	Df	Sig
			Mean	Std. Dev.			
Berg balance scale	Pre	Exp -1	15.00	3.52542	16.479	14	.000
	Post	Exp -2	40.27	2.60403	59.889		

Graph III - Statistical Result of Berg balance scale Dependent "t" test



A) Comparing the pretest and post test values of experimental group -1 (Core stability strength exercise group)

The mean pretest Berg balance scale score (BBS) of group -1 is 16.67 and mean post test BBS score of group-1 is 21.20. Calculated "t" value for wrist flexion is 16.479 which is greater than table value at .01 level of significance showing that there is significant difference between two values. This shows the efficacy of Core stability strength exercise along with conventional therapy.

B) Comparing the pre test and post test values of experimental group - 2 (Trunk stabilization exercise group)

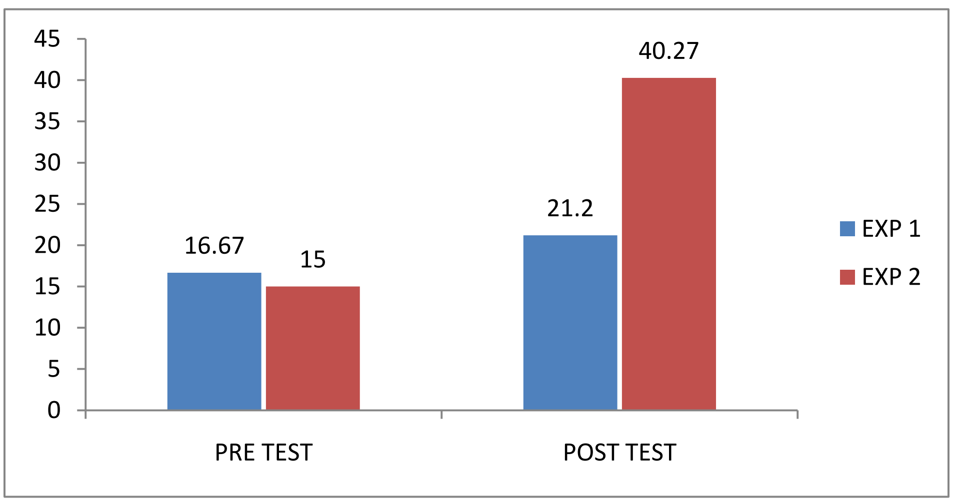
The mean pretest wrist flexion score of experimental group is 15.00 and the mean post test wrist flexion score is 40.27. Calculated "t" value is which is 59.889 greater than the table value, at .01 level of significance, showing that there is significant difference between the two values. This shows the efficacy of Trunk stabilization exercise in improving postural control and balance of the hemiplegic patients.

Analysis of results Using Independent "t" test – Berg balance scale

Table V - Statistical result of Berg balance scale Independent "t" test

Group	Pre Test			Post Test		
	Mean	SD	Independent T	Mean	SD	Independent T
Exp 1	16.67	3.37357	1.323	21.20	3.27763	17.640*
Exp 2	15.00	3.52542		40.27	2.60403	

Graph IV - Statistical Result of Pre & Post Test Berg balance scale – Both Groups



A) Comparing pre test Berg Balance scale score of experimental group 1 and 2

Mean pre test BBS of experimental group1 is 16.67 and that for experimental group 2 is 15. Calculated "t" value 1.323 is less than that of table value at .01 level of significance showing that there is no significant difference between two groups. We can conclude that both the groups are homogenous.

B) Comparing post test Berg Balance scale score of experimental group 1 and 2

Mean post test BBS score of experimental group 1 is 12.10 and that for experimental group 2 is 40.27. Calculated "t" value is 17.640 greater than that of table value at .01 level of significance, showing that there is significant difference between two groups. From statistical analysis Berg balance scale score (BBS) are significantly improved in experimental group 2 when compared with that of experimental group 1. Hence we can conclude that there is significant improvement in the postural control and balance, of experimental group 2 which received Trunk stabilization exercise in addition to the conventional therapy for hemiplegic patients.

4.2 RESULT

The results of the statistical analysis showed significant improvement in postural control and balance of the experimental group 2 over experimental group 1. Thus it can be concluded that trunk stabilization exercise in addition to the conventional therapy can be used to improve the postural control and balance of the sub acute hemiplegic patients.

CHAPTER V

DISCUSSION

The research work was experimental comparative approach, which studied the effectiveness of Core stability strength exercise and Trunk stabilization exercise in addition to the conventional therapy to improve the postural control and balance of hemiplegic patients. For this study 30 patients from PPG College of Physiotherapy and Ashwin hospital were recruited. From this sample of 30, the subjects were divided into 2 groups consisting of 15 subjects each. The age and duration of the subjects were almost similar in both groups. Out of 15 patients in experimental group - 1, 11 were male patients and 4 were female patients. Out of 15 patients in experimental group - 2 were 12 were male patients and 3 were female patients. The outcome measurement was done by Trunk Impairment Scale (TIS) and Berg balance Scale (BBS).

The outcome measurement for this study is widely used and yields scores that are reliable and valid. The group I conducted the Core stability strength exercise, in addition to existing rehabilitation exercises five times per week for 12 weeks. The group II conducted the trunk stabilization exercises on the respective support surfaces, in addition to existing rehabilitation exercises five times per week for 12 weeks. Both groups conducted warming up exercises for 5 minutes, the main exercise for 20 minutes, and cooling-down exercises for 5 minutes, for a total of 30 minutes, in addition to existing rehabilitation treatment five times per week for 12 weeks. Both groups were assessed on the first and last day of treatment. Along with conventional therapy, Core stability strength exercise and Trunk stabilization exercise were given to the experimental group 1 and 2. The results of the present study indicate that trunk stabilization exercise along with conventional therapy is more effective, thereby supporting the experimental hypothesis. Data were analyzed using Independent‟s‟ test and Dependent‟s‟ tests. Results showed significant improvement in the post test scores of experimental group 1 and 2. The experimental group 1 consists of 15 patients. Mean pretest score of TIS for experimental group - 1was 8.7333 and for BBS was 16.67. After 12 weeks treatment programme the mean post test was 9.80 and 21.20 respectively. The experimental group 2 also had 15 patients who were satisfying the inclusion criteria. Mean pre test score of TIS for experimental group – 2 was 9.0000 and for BBS was 15.00. After 12 weeks treatment programme the mean post test was

18.5333 and 40.27 respectively. The difference may be due to combined effect of conventional therapy and trunk stabilization exercise.

On statistical analysis using Independent and Dependent "t" test, it was found that there is significant difference in the post test scores of experimental group – 2 over the experimental group -1 in stroke rehabilitation, thus rejecting the null hypothesis.

From these findings it can be stated that experimental group - 2 performed better than experimental group - 1 and there was significant improvement in postural control and balance of the hemiplegic patients. This study shows that the trunk stabilization exercise in addition to conventional therapy was more beneficial in terms of postural control and balance of the hemiplegic patients than the core stability strength exercise along with conventional Physiotherapy. The study has proved that trunk stabilization exercise has measurable effect on postural control and balance. Studies were conducted in the similar aspect by Jihye Jung et al in 2015; this study investigated the effects of trunk stabilization training using visual feedback on an unstable surface to improve balance and trunk stability of individuals with chronic stroke debility. Trunk stabilization training using visual feedback improved sitting balance and the ability to control the trunk of patients in the sitting position. This training would be an effective way to exercise in order to promote functional activity in the sitting position. Another study was by Junsang Yoo et al in 2014; this study investigated the effect of unstable surface trunk stabilization exercise on the abdominal muscle structure and balance of stroke patients. The unstable surface trunk stabilization exercise improved the internal oblique and transversus abdominis muscles and balance ability. These results suggest that unstable surface trunk exercise is useful in the rehabilitation stroke patients. The somatosensory system provides the CNS with position and motion information about the body with reference to supporting surfaces. Also somatosensory inputs throughout the body report information about the relationship of body segment to one another and hence maintaining balance. Since stroke subjects often present with somatosensory deficits, the adaptation of regular exercises with the use of surface and vision manipulation to challenge balance could improve the process of somatosensory integration and have a positive effect on postural stability (Nicola S et al, 2008). The trunk is the center of the body, and it plays a postural role in functional movement by preparing the body for the movement of the extremities against gravity. It also plays an active role in smoothing the movement of the center of gravity, and it enables ease of movement into a new posture. Balance is the result of interactions among the visual system, vestibular system, proprioceptive system, musculoskeletal system, and cognitive ability. Balance maintenance is a very important element for safe and independent performance in ordinary life of movements and walking (Ryerson S et al, 2008). Stroke patients suffer from balance disability due to abnormalities in the proprioceptive system, sensory system, trunk muscles, and muscles of the limbs. Stroke often causes paralysis on the affected side as soon as it occurs, decreasing the adjustment ability of the trunk. In particular, reduction in the activity of the muscles of the trunk reduces movement of the pelvis, leading to the development of asymmetry of the trunk, and preventing use of strategies protecting against the risk of balance loss. A previous study evaluated the trunk muscles of stroke patients and normal age-matched controls using a handheld dynamometer and found that stroke patients' bilateral lateral flexors were weaker. A study that used an isokinetic dynamometer reported that trunk flexors, extensors, and bilateral rotators were weakened in stroke patients (Karatas M et al, 2004).

The researchers also have done the study on core muscle strength exercise on posture and balance for post stroke patients. Rosa Cabanas Valdés et al in 2015; they have studied on the effect of additional core stability exercises on improving dynamic sitting balance and trunk control for sub acute stroke patients: A randomized controlled trial. To examine the effect of core stability exercises on trunk control, dynamic sitting and standing balance, gait, and activities of daily living in subacute stroke patients. Core stability exercises in addition to conventional therapy improves trunk control, dynamic sitting balance, standing balance, gait and activities of daily living in subacute post-stroke patients. Eun-Jung Chung et al in 2013; they have studied on the effects of core stabilization exercise on dynamic balance and gait function in Stroke patients. The purpose of this study was to determine the effects of core stabilization exercise on dynamic balance and gait function in stroke patients. The core exercise group showed a significant change in TUG, velocity, and cadence. The only significant difference observed between the core group and control group was in velocity. Conclusion: The results of this study suggest the feasibility and suitability of core stabilization exercise for stroke patients.

Stroke patients experience weakened trunk muscles on the unaffected side, as well as the affected side. Therefore, evaluation of the trunk should be made on the affected and unaffected sides. The trunk exercise on a stable support surface with subacute stroke patients and reported that the functions of their trunks improved and observed that exercise on different support surfaces had a positive influence on subacute stroke patients (Verheyden G et al 2009). An unstable support surface stimulated the sensory system and the motor system more than a stable support surface, effectively changing postural orientation ability and aiding postural strategies. Until now, clinical evaluation tools for the assessment of stroke patients' trunks have been used. To improve the strength of the trunk muscles, the abdominal muscles, and the multifidus muscles, the small muscles of the vertebrae need to be harmoniously activated. These muscles are tonic or postural muscles and the muscle imbalance necessary for the stability of the trunk and for postural adjustment are improved during whole body exercise. When improving the strength of the trunk muscles, an increase in the cross-sectional area of the trunk muscles does not occur during the first four weeks of exercise. The observed increase in muscle strength is due to adaptation in the neurological system. The increase in the strength of the muscles owing to an increase in the cross-sectional area of the muscles occurs eight weeks after the start of exercise. This study conducted trunk stabilization exercises for 12 weeks on a stable support surface (group I) and on an unstable support surface (group II), with stroke patients whose onset of stroke had occurred six months earlier or longer and determined the effects of the changes in cross-sectional areas of subjects' trunk muscles and their balance. The tensile force exerted by the muscles exhibits performance of muscle strength in proportion to the cross-sectional area if neurological adaptation is unaffected. However, in the present study, the subjects had diseases of the central nervous system. Thus, changes in the cross-sectional areaof their trunk muscles may not have been proportionate to changes in muscle strength. Nevertheless, changes in the cross-sectional area may serve as an index that indicates changes in the muscles. Using CT, this study analyzed the cross-sectional areas of the multifidus, deep stabilizer muscles and the paravertebral, superficial stabilizer muscles by dividing them into those on the side contralateral to the brain lesion and thosed on the side ipsilateral to the brain lesion. The results show that the cross-sectional area of the trunk muscles on the side contralateral to the brain lesion significantly increased after the exercise. Ferbert et al. conducted transcortical magnetic stimulation on one hemisphere of normal subjectsand the recorded motor evoked potential (MEP) on the bilateral paravertebral. Fujiwara et al. conducted transcorticalmagnetic stimulation on the cerebral hemisphere of stroke patients on the non-paretic side. They found that changes in the MEP of the paravertebral muscles on the contralateral side o the brain lesion were more significant than those of normal subjects. Another study showed that compensatory activities through uncrossed pathways of the unaffected hemisphere are involved in functional recovery of the trunk. In the present study, the strength of the trunk muscles improved in the two groups. The results for group I were similar to those of Verheyden et al. who conducted trunk exercise on a stable support surface for stroke patients. Comparing the two groups, the improvement in the multifidus, deep muscles, of group II showed the most significant difference. This result suggests that exercise on an unstable support surface is more effective at activating the trunk muscle tissue than that on a stable support surface. In other words, diverse movement on an unstable support surface appears to provide postural perturbation enhancing the maintenance of desired postures. In the present study, exercise on the unstable support surface improved lower trunk muscle stabilization exercise, increasing the stability of the pelvis and affecting the mobility of the upper trunk and distal lower extremities, thereby improving balance. Therefore, exercise on an unstable support surface provides a superior environment for trunk muscle exercises for stroke patients by increasing the crosssectional areas of the trunk muscles and improving balance ability compare to the Core stability strength training which provides the effect on stable support as the technique handled on the table in lying position. Therefore researcher thought of doing this research to understand the difference between these two techniques.

Hence it can be stated that trunk stabilization with conventional physical therapy is effective in improving postural control and balance of the sub acute hemiplegic patients. Numerous kinds of facilitative techniques have been proposed and estimated to reduce functional impairment and disability of stroke patients. Those treatments are more complicated and expensive than core stability strength and trunk stabilization exercise. In addition, it was found from the study that trunk stabilization exercise (20 -30 minutes daily) could maximize the postural control and balance of the sub acute hemiplegic patients. The intervention is not complex and the materials used are easily available, once the patient masters it, may be feasible for home use by many patients.

CHAPTER VI

SUMMARY AND CONCLUSION

6.1 SUMMARY

The impairment in postural control and balance following stroke is one of the most debilitating condition for the patients and the recovery of these lost functions are the greatest challenge for the physical therapist and care takers of the patient. The purpose of this study was to determine the effectiveness of the core stability strength exercise and trunk stabilization exercise in addition to the conventional Physiotherapy. The study was an experimental comparative research. The population selected included hemiplegic patients due to cerebral artery stroke. By using non-probability convenient sampling the 30 subjects were selected and randomly assigned into two groups, the experimental group 1 and 2.

The outcome measurement used was Trunk Impairment Scale (TIS) and Berg Balance Scale (BBS), with maximum score of 23 and 56. The duration of the treatment was 12 weeks. Both experimental group 1 and 2 received conventional physical therapy. In addition core stability strength exercise and trunk stabilization exercise was given to the experimental groups. The outcome measurement was measured before and after the administration of the 12 weeks treatment programme. The data were analyzed using independent and dependent “t” test.

6.2 CONCLUSION

The study proves that trunk stabilization exercise in addition to the conventional therapy is more effective in improving postural control and balance of hemiplegic patient, than the core stability strength exercise along with conventional therapy. So trunk stabilization exercise in addition to the conventional therapy can be used as an effective treatment programme in improving postural control and balance of hemiplegic patients than receiving core stability strength with conventional physical therapy. This helps the patient to improve the quality of functional independence.

CHAPTER VII

LIMITATIONS AND SUGGESTIONS

1. Time allotted for data collection was 3 months.
2. Sample size was small, which reduces the generalisability.
3. No specific side of the hemiplegic patients have been selected
4. Hemiplegic patients of 1-3month duration only were considered
5. Duration of treatment programme was only 12 weeks.
6. The study assessed only short term progress of the patient. Long term follow up is needed to evaluate the differences in the condition of the patients from current status.

SUGGESTIONS

1. Further study can be conducted with more samples size.
2. Further studies can be done in chronic hemiplegic patients
3. Long term follow up is needed to evaluate the differences in the condition of the patients from the current status.
4. Further study is needed to systematically determine the most efficacious protocol for the patient.
5. Further study is suggested with more specific cortical and sub cortical stroke.
6. Randomized studies are needed to establish whether core stability strength exercise and trunk stabilization exercise durably improves postural control and balance of the sub acute hemiplegic patients
7. Further studies should be undertaken with the similar patient group to confirm the findings of the study.

CHAPTER VIII

REFERENCES

1. **Ryerson S, Byl NN, Brown DA, et al.,** Altered trunk position sense and its relation to balance functions in people post-stroke. J Neurol Phys Ther, 2008.
2. **Karatas M, Cetin N, Bayramoqlu M, et al.,** Trunk muscle strength in relation to balance and functional disability in unihemispheric stroke patients. Am J Phys Med Rehabil, 2004
3. **Kelley RE**, Borazanci AP: Stroke rehabilitation. Neurol Res, 2009.
4. **Tyson SF**, Hanley M, Chillala J, et al.: Balance disability after stroke. PhysTher, 2006.
5. **Messier S**, Bourbonnais D, Desrosiers J, et al.: Dynamic analysis of trunk flexion after stroke. Arch Phys Med Rehabil, 2004.
6. **Bohannon RW:** Lateral trunk flexion strength: impairment, measurement reliability and implications following unilateral brain lesion. Int J Rehabil Res, 1992.
7. **Tanaka S,** Hachisuka K, Ogata H: Muscle strength of the trunk flexion-extension in post-stroke hemiplegic patients. Am J Phys Med Rehabil, 1998.
8. **Tanaka S**, Hachisuka K, Ogata H: Trunk rotatory muscle performance in post-stroke hemiplegic patients. Am J Phys Med Rehabil, 1997.
9. **Verheyden G,** Vereeck L, Truijen S, et al.: Additional exercises improve trunk performance after stroke: a pilot randomized controlled trial. Neurorehabil Neural Repair, 2009.
10. **Bayouk JF**, Boucher JP, Leroux A: Balance training following stroke: effects of task-oriented exercises with and without altered sensory input. Int J Rehabil Res, 2006.
11. **Shumway-Cook A**, Woollacott MH: Motor control: translating research into clinical practice, 3rd ed, Philadelphia: Lippincott Williams &Wilkins, 2007.
12. **Tsuji T, Liu M,** Hase K, et al.: Trunk muscles in persons with hemiparetic stroke evaluated with computed tomography. J Rehabil Med, 2003.
13. **Karthikbabu S**, Rao BK, Manikandan N, et al.: Role of trunk rehabilitation on trunk control, balance and gait in patients with chronic stroke: A prepost design. Neurosci Med, 2011.
14. **Danneels LA**, Vanderstraeten GG, Cambier DC, et al.: CT imaging of trunk muscles in chronic low back pain patients and healthy control subjects. Eur Spine J, 2000.

15. **Onambele GL**, Narici MV, Maqanaris CN: Calf muscle-tendon properties and postural balance in old age. J Appl Physiol, 2006.
16. **Verheyden G,** Nieuwboer A, Mertin J, et al.: The trunk impairment scale: a new tool to measure motor impairment of the trunk after stroke. Clin Rehabil, 2004.
17. **Kibler WB**, Press J, Sciascia A: The role of core stability in athletic function. Sports Med, 2006.
18. **Jackson PL**, Lafleur MF, Malouin F, et al.: Potential role of mental practice using motor imagery in neurologic rehabilitation. Arch Phys Med Rehabil, 2001.
19. **Dickstein R, Sheffi S**, Markovici E, et al.: Anticipatory postural adjustment in selected trunk muscles in post stroke hemiparetic patients. Arch Phys Med Rehabil, 2004.
20. **Behm DG**, Anderson K, Curnew RS: Muscle force and activation under stable and unstable conditions. J Strength Cond Res, 2002.
21. **Marshall PW,** Murphy BA: Core stability exercise on and off a swiss ball. Arch Phys Med Rehabil, 2005.
22. **Jones DA,** Rutherford OM, Parker DF: Physiological changes in skeletal muscle as a result of strength training. Q J Exp Physiol, 1989.
23. **Alway SE,** Stray-Gundersen J, Grumbt WH, et al.: Muscle cross-sectional area and torque in resistance-trained subjects. Eur J Appl Physiol Occup Physiol, 1990.
24. **Ferbert A**, Caramia D, Priori A, et al.: Cortical projection to erector spinae muscles in man as assessed by focal transcranial magnetic stimulation. Electroencephalogr Clin Neurophysiol, 1992.
25. **Fujiwara T,** Sonoda S, Okajima Y, et al.: The relationships between trunk function and the findings of transcranial magnetic stimulation among stroke patients. J Rehabil Med, 2001.
26. **Jacobs KM**, Donoghue JP: Reshaping the cortical motor map by unmasking latent intracortical connections. Science, 1991.
27. **Liggett CA**, Randolph M: Comparison of abdominal muscle strength following ball and mat exercise regimens: a pilot study. J Manual Manip Ther, 1999.
28. **van Nes IJ**, Nienhuis B, Latour H, et al.: Posturographic assessment of sitting balance recovery in the subacute phase of stroke. Gait Posture, 2008.
29. **Chern JS**, Lo CY, Wu CY, et al.: Dynamic postural control during trunk bending and reaching in healthy adults and stroke patients. Am J Phys Med Rehabil, 2010.

30. **Verheyden G**, Vereeck L, Truijen S, et al.: Trunk performance after stroke and relationship with balance, gait and functional ability. Clin Rehabil, 2006.

31. **Akuthota V,** Nadler SF. Core strengthening. Arch phys Med Rehabil 2004.

32. **Bach-y-Rita P.** Brain plasticity as a basis of the development of rehabilita tion procedures for hemiplegia. Scand J Rehabil Med 1981.

33.**Barnett HJ,** Eliasziw M, Meldrum HE. Evidence based cardiology: Prevention of ischemic stroke. BMJ 1999.

34. **Bobath B**. Adult hemiplegia: Evaluation and treatment: 3rd. London, England: Heinemann Medical Book. 1990.

35. **Carr JH**, Shepherd RB, Nordholm L. Lynne D. Inverstigation of new motor assessment scale for stroke patients. Phys Ther 1985.

36. **Cram JR**, Kasman GS, Holtz J. Introduction to surface electromyography. Gaithersburg, Marland: Aspen publishers Inc. 1998.

37. **Cresswell AG**, Oddsson L, Thorstensson A. The influence of sudden perturbations on trunk muscle activity and intra-abdominal pressure while standing. Exp Brain Res 1994.

38. **Dickstein R**, Hocherman S, Pillar T Shaham R. Stroke rehabilitation. Three exercise therapy approaches. Phys Ther 1986.

39. **Feigin L,** Sharon B, Czaczkes B, Rosin AJ. Sitting equilibrium 2 weeks after a stroke can predict the walking ability after 6 months. Gerontology 1996.

40. **Forster A**, Szabo K, Hennerici MG. Machanisms of disease: Pathophysiological concept of stroke in hemodynamic risk zones--do hypoperfusion and embolism interact. Nat Clin Pract Neurol, 2008.

41. **Handa N,** Yamamoto H, Tani T, Kawakami T, Takemasa R. The effect of trunk muscle exercises in patients over 40 years of age with chronic low back pain. J Orthop Sci 2000.

42. **Hodges PW**, Richardson CA. Contraction of the abdominal muscles associated with movement of the lower limb. Phys Ther 1997.

43. **Hsieh CL**, Sheu CF, Hsueh IP, Wang CH. Trunk control as an early predictor of comprehensive activities of daily living function in stroke patients. Stroke 2002.

44. **Johansson R**, Magnusson M. Human postural dynamics. Crit Rev Biomed Eng 1991.

45. **Kibler WB**, Press J, Sciascia A. The role of core stability in athletic function. Sports Med 2006.

46. **Kim Suhn-Yeop,** Kwon Jae-Hoak. Lumbar stability exercises using the sling system. J of Kor Acad Orth Manu Ther 2001.

47. **Konin JG**, Beil N, Werner G. Functional rehabilitation. Facilitating the serape effect to enhance extremity force production. Athl Ther Today 2003.

48. **Lee Byoung-Hee**, Baek Ji-Young. The effects of core stability training on static and dynamic balance of stroke patients. J Kor Spor Health 2007.

49. **Massion J**. Postural control system. Curr Opin Neurobiol 1994;4:877-887.
Marshall PW, Murphy BA. Core stability exercises on and off a Swiss ball. Arch Phys Med Rehabil 2005.

50. **Panjabi MM**. The stabilizing system of the spine. Part I: Function, dysfunction adaptation, and enhancement. J Spinal Disord 1992.

51. **Porterfield JA**, Derosa C. Mechanical low back pain: perspecitves in functional anatomy. 2nd. Philadelphia: W.B. Saunders Company 1998.

52. **Rasmussen-Barr E**, Nilsson-Wikmar L, Arvidsson I. Stabilizing training compared with manual treatment in sub-acute and chronic low-back pain. Man Ther 2003.

53. **Richardson CA**, Jull GA. Muscle control-pain control. What exercises would you prescribe? Man Ther 1995.

54. **Ryerson S, By**l NN, Brown DA, Wong RA, Hidler JM. Altered trunk position sense and its relation to balance functions in people post-stroke. J Neurol Phys Ther 2008.

55. **Patricia A**. **Downie**. Cash textbook of neurology for Physiotherapist. 4th ed; 1993.

56. **Tapas KB, Shyamal KD**. Epidemiology of stroke in India. Neurology Asia. 2006.

57**. Dipesh KM**, Sobhana A. Stroke foundation of Bengal. 2011.

58. **Sullivan B. O' Sullivan**, Thomas J. Schmitz. Physical Rehabilitation. 5th ed; 2006.

59. **Nicola S, Alessandro P**, Marialuisa G, Antonio F, Michele T. Rehabilitation of sensorimotor integration deficits in balance impairment of patients with stroke hemiparesis: a before/after pilot study. Neurological Science. 2008.

60. **Ibrahimi N, Tufel S**, Singh H, Maurya M. Effect of sitting balance training under varied sensory input on balance and quality of life in stroke patients. Indian Journal of Physiotherapy and Occupational therapy, 2010.

CHAPTER IX

ANNEXURE

ANNEXURE I - INFORMED CONSENT FORM

TITLE: Efficacy of conventional physiotherapy with core stability strength exercise and conventional physiotherapy with trunk stabilization exercise on recovery of postural control and balance in hemiplegic patients

INVESTIGATOR:

CO-INVESTIGATORS:

PURPOSE OF THE STUDY:

I -- ---------- have been informed that this study will help clinicians ,& therapists to find out the -- -- --

PROCEDURE:

I understand that I' ll undergo -- -- ------------------------under the direct supervision of the physiotherapist. I am aware that I have to follow therapist's instruction as has been told to me.

RISK AND DISCOMFORT:

I understand that there are no potential risks associated with this procedure, and understand that-- will accompany me during this procedure. There are no known hazards associated with this procedure.

CONFIDENTIALITY:

I understand that the medical information produced by this study will be confidential. If the data are used for publication in the medical literature or for teaching purpose, no names will be used. And photographs, audio and videotapes will be used without identity for publication and presentation.

PHOTOGRAPHY CONSENT:

Have explained to me that photography are required in order to illustrate various aspects of the study for the thesis and other articles, and at the presentation or conference. By giving my consent I authorize---------------------------------- to use any of the photographs taken of me in printed format, in slides for presentation.

REQUEST FOR MORE INFORMATION:

I understand that I may ask any question about the study at any times. ----------------------- are available to answer my question. Copy of this concern form will be given to me keep for my careful reading.

REFUSAL OR WITHDRAWAL OF PARTICIPATION:

I understand that my participation is voluntary and I may withdraw consent and discontinue participation at any time after he has explained the reasons for doing so.

INJURY STATEMENT:

I understand that the diagnostic/ treatment procedure, under the guidance of my therapist, is likely to cause any / no injury. In such case medical attention will be provide, but no compensation will be provided. I understand my agreement to participation in this study and I am not waiving any of my legal rights. I confirm that-- -- have explained me the purpose of the study, the study procedure and possible rick that I may experience.

I have read and I have understood this concern to participate as a subject in this study.

------------------------------ --------------------

SUBJECT **DATE**

------------------------------ -----------------

WITNESS SIGNATURE **DATE**

I have explained--the purpose of the research, the procedure required and the possible risks and benefits, to the best of my ability.

------------------------------ -----------------

INVESTIGATOR **DATE**

ANNEXURE II

ASSESSMENT CHART

- Name :
- Age :
- Sex :
- Occupation :
- Handedness :
- Side of affection :
- Duration :

Chief complaints:

Medical history :

- Previous medical history of stroke

General examinations :

Neurological examination :

- Higher functions: (MMSE)
- Cranial nerve examination
- Sensory examination
- Motor Examination

Intervention:

Conventional Physiotherapy with Core stability strength exercise

Conventional Physiotherapy with exercise Trunk stabilization exercise

Prognosis chart

Parameter	Pre test score	Post test score
Conventional Physiotherapy with Core stability strength exercise		
Conventional Physiotherapy with exercise Trunk stabilization exercise		

ANNEXURE III

PARAMETER

BRUNNSTORM RECOVERY STAGES OF HEMIPLEGIA

Stage 1): Immediately following the acute episode, flaccidity of the involved limb is present, and no movement, on either a reflex or voluntary basis, can be initiated.

Stage 2): As recovery begins, the basic limb synergies or some of their components may appear as associated reactions, or minimal voluntary movements' responses may be present. Spasticity begins to develop may be particularly evident in muscle groups that dominate synergy movements.

Stage 3): The patient's gains voluntary control of movements' synergies, although full range of all synergy components does not necessarily develop. Spasticity which may become severe in some cases, reaches its peak. This stage in the recovery process may be thought of as semi voluntary in that the patient is able to initiate movement in the involved limbs on a volitional basis but is unable to control the form of the resulting movement, which will be the basic limb synergies.

Stage 4): Some movement combinations that do not follow the paths of the basic limb synergies are mastered, first with difficulty, than with increasing ease. Spasticity begins to decline, but the influence of spasticity on no synergistic movements is still readily observable.

Stage 5): If the recovery continues, more difficult movement combinations are mastered as the basic limb synergies lose their dominance over motor acts. Spasticity continues to decline.

Stage 6): Individual joint movements become possible, and coordination approaches normalcy. As the spasticity disappears the patient become capable of a full spectrum of movement patterns.

Stage 7): As the last recovery stage normal motor function is restored.

TRUNK IMPAIRMENT SCALE

INSTRUMENT NAME: Trunk Impairment Scale (TIS)

The Trunk Impairment Scale (TIS) was developed to measure motor impairment of the trunk after stroke.

EQUIPMENT NEEDED:

- Pen/pencil
- Bed or treatment table
- Stopwatch may be useful for timed items

ADMINISTRATION INSTRUCTIONS:

Time to administer and score: 10 minutes3

Starting position is the same for all items (patient sitting on the edge of the bed or treatment table without back and arm support). The thighs should be in full contact with the bed/table, the feet are hip width apart and placed flat on the floor, knee angle at 90 degree, the arms resting on the legs, and head/trunk in midline.

- The patient can be corrected between attempts.
- The test items are explained verbally and may be demonstrated.
- If the patient scores 0 on the first item (static sitting balance: starting position) the TIS score is 0.
- For patients with stroke, on static sitting balance item #3 (patient crosses unaffected leg over the hemiplegic leg), the patient should cross the stronger leg (determined via manual resistance by therapist) over the weaker leg; if no difference in strength is found, the patient may select which leg to use for crossing the leg.

STATIC SITTING BALANCE:

Position	Procedure	Score
1. Starting position	Patient falls or cannot maintain starting position for 10 seconds without arm support Patient can maintain starting position for 10 seconds If score= 0, then TIS total score=0	**0** **2**
2. Starting position therapist crosses the unaffected leg over the hemiplegic leg	Patient falls or cannot maintain sitting position for 10 seconds without arm support Patient can maintain sitting position for 10 seconds	**0** **2**
3.Starting position Patient crosses the unaffected leg over the hemiplegic leg	Patient falls Patient cannot cross the legs without arm support on bed or table Patient crosses the legs but displaces the trunk more than 10 cm backwards or assists crossing with the hand Patient crosses the legs without trunk displacement or assistance	**0** **1** **2** **3**
	Total static sitting balance	/ 7

DYNAMIC SITTING BALANCE:

Position	Procedure	Score
1. Starting position Patient is instructed to touch the bed or table with the hemiplegic elbow (by shortening the hemiplegic side and lengthening the unaffected side) and return to the starting position	Patient falls, needs support from an upper extremity or the elbow does not touch the bed or table Patient moves actively without help, elbow touches bed or table If score= 0, then items 2 and 3 score 0	**0** **1**
2. Repeat item 1	Patient demonstrates no or opposite shortening/lengthening Patient demonstrates appropriate shortening/lengthening If score= 0, then item 3 scores 0	**0** **1**
3. Repeat item 1	Patient compensates. Possible compensations are: (1) use of upper extremity, (2) contralateral hip abduction, (3) hip flexion (if elbow touches bed or table further then proximal half of femur), (4) knee flexion, (5) sliding of the feet Patient moves without compensation	**0** **1**
4. Starting position Patient is instructed to touch the bed or table with the unaffected elbow (by shortening the unaffected side and lengthening the hemiplegic side) and return to the starting position	Patient falls, needs support from an upper extremity or the elbow does not touch the bed or table Patient moves actively without help, elbow touches bed or table If score= 0, then items 5 and 6 score 0	**0** **1**
5. Repeat item 4	Patient demonstrates no or opposite shortening/lengthening Patient demonstrates appropriate shortening/lengthening If score= 0, then item 6 scores 0	**0** **1**

6. Repeat item 4	Patient compensates. Possible compensations are: (1) use of upper extremity, (2) contralateral hip abduction, (3) hip flexion (if elbow touches bed or table further then proximal half of femur), (4) knee flexion, (5) sliding of the feet Patient moves without compensation	**0** **1**
7. Starting position Patient is instructed to lift pelvis from bed or table at the hemiplegic side (by shortening the hemiplegic side and lengthening the unaffected side) and return to the starting position	Patient demonstrates no or opposite shortening/lengthening Patient demonstrates appropriate shortening/lengthening If score= 0, then item 8 scores 0	**0** **1**
8. Repeat item 7	Patient compensates. Possible compensations are: (1) use of upper extremity, (2) pushing off with the ipsilateral foot (heel loses contact with the floor) Patient moves without compensation	**0** **1**
9. Starting position Patient is instructed to lift pelvis from bed or table at the unaffected side (by shortening the unaffected side and lengthening the hemiplegic side) and return to the starting position	Patient demonstrates no or opposite shortening/lengthening Patient demonstrates appropriate shortening/lengthening If score= 0, then item 10 scores 0	**0** **1**
10. Repeat item 9	Patient compensates. Possible compensations are: (1) use of upper extremities, (2) pushing off with the ipsilateral foot (heel loses contact with the floor) Patient moves without compensation	**0** **1**
	Total dynamic sitting balance	**/ 10**

CO-ORDINATION:

1. Starting position Patient is instructed to rotate upper trunk 6 times (every shoulder should be moved forward 3 times), first side that moves must be hemiplegic side, head should be fixated in starting position	Hemiplegic side is not moved three times e 0 Rotation is asymmetrical Rotation is symmetrical *If score= 0, then item 2 scores 0*	0 1 2
2. Repeat item 1 within 6 seconds	Rotation is asymmetrical Rotation is symmetrical	0 1
3. Starting position Patient is instructed to rotate lower trunk 6 times (every knee should be moved forward 3 times), first side that moves must be hemiplegic side, upper trunk should be fixated in starting position	Hemiplegic side is not moved three times Rotation is asymmetrical Rotation is symmetrical *If score= 0, then item 4 scores 0*	0 1 2
4 Repeat item 3 within 6 seconds	Rotation is asymmetrical e 0 Rotation is symmetrical	0 1
	Total co-ordination	/6

Total Trunk Impairment Scale score /23

BERG BALANCE SCALE

The Berg Balance Scale (BBS) was developed to measure balance among older people with impairment in balance function by assessing the performance of functional tasks. It is a valid instrument used for evaluation of the effectiveness of interventions and for quantitative descriptions of function in clinical practice and research. The BBS has been evaluated in several reliability studies. A recent study of the BBS, which was completed in Finland, indicates that a change of eight (8) BBS points is required to reveal a genuine change in function between two assessments among older people who are dependent in ADL and living in residential care facilities.

Description:

14-item scale designed to measure balance of the older adult in a clinical setting.

Equipment needed:

Ruler, two standard chairs (one with arm rests, one without), footstool or step, stopwatch or wristwatch, 15 ft walkway.

Completion:

Time: 15-20 minutes

Scoring: A five-point scale, ranging from 0-4. "0" indicates the lowest level of function and "4" the highest level of function. Total Score = 56

Interpretation:

41-56 = low fall risk
21-40 = medium fall risk
0 –20 = high fall risk

A change of 8 points is required to reveal a genuine change in function between 2 assessments.

1. SITTING TO STANDING

INSTRUCTIONS: Please stand up. Try not to use your hand for support.

( ) 4 able to stand without using hands and stabilize independently

( ) 3 able to stand independently using hands

( ) 2 able to stand using hands after several tries

( ) 1 needs minimal aid to stand or stabilize

( ) 0 needs moderate or maximal assist to stand

2. STANDING UNSUPPORTED

INSTRUCTIONS: Please stand for two minutes without holding on.

( ) 4 able to stand safely for 2 minutes

( ) 3 able to stand 2 minutes with supervision

( ) 2 able to stand 30 seconds unsupported

( ) 1 needs several tries to stand 30 seconds unsupported

( ) 0 unable to stand 30 seconds unsupported

If a subject is able to stand 2 minutes unsupported, score full points for sitting unsupported. Proceed to item #4.

3. SITTING WITH BACK UNSUPPORTED BUT FEET SUPPORTED ON FLOOR OR ON A STOOL

INSTRUCTIONS: Please sit with arms folded for 2 minutes.

( ) 4 able to sit safely and securely for 2 minutes

( ) 3 able to sit 2 minutes under supervision

( ) 2 able to able to sit 30 seconds

( ) 1 able to sit 10 seconds

( ) 0 unable to sit without support 10 seconds

4. **STANDING TO SITTING**

INSTRUCTIONS: Please sit down.

( ) 4 sits safely with minimal use of hands

( ) 3 controls descent by using hands

( ) 2 uses back of legs against chair to control descent

( ) 1 sits independently but has uncontrolled descent

( ) 0 needs assist to sit

5. TRANSFERS

INSTRUCTIONS: Arrange chair(s) for pivot transfer. Ask subject to transfer one way toward a seat with armrests and one way toward a seat without armrests. You may use two chairs (one with and one without armrests) or a bed and a chair.

( ) 4 able to transfer safely with minor use of hands

( ) 3 able to transfer safely definite need of hands

( ) 2 able to transfer with verbal cuing and/or supervision

( ) 1 needs one person to assist

( ) 0 needs two people to assist or supervise to be safe

6. STANDING UNSUPPORTED WITH EYES CLOSED

INSTRUCTIONS: Please close your eyes and stand still for 10 seconds.

( ) 4 able to stand 10 seconds safely

( ) 3 able to stand 10 seconds with supervision

( ) 2 able to stand 3 seconds

( ) 1 unable to keep eyes closed 3 seconds but stays safely

( ) 0 needs help to keep from falling

7. STANDING UNSUPPORTED WITH FEET TOGETHER

INSTRUCTIONS: Place your feet together and stand without holding on.

( ) 4 able to place feet together independently and stand 1 minute safely

( ) 3 able to place feet together independently and stand 1 minute with supervision

( ) 2 able to place feet together independently but unable to hold for 30 seconds

( ) 1 needs help to attain position but able to stand 15 seconds feet together

( ) 0 needs help to attain position and unable to hold for 15 seconds

8. REACHING FORWARD WITH OUTSTRETCHED ARM WHILE STANDING

INSTRUCTIONS: Lift arm to 90 degrees. Stretch out your fingers and reach forward as far as you can. (Examiner places a ruler at the end of fingertips when arm is at 90 degrees. Fingers should not touch the ruler while reaching forward. The recorded measure is the distance forward that the fingers reach while the subject is in the most forward lean position. When possible, ask subject to use both arms when reaching to avoid rotation of the trunk.)

( ) 4 can reach forward confidently 25 cm (10 inches)

( ) 3 can reach forward 12 cm (5 inches)

( ) 2 can reach forward 5 cm (2 inches)

( ) 1 reaches forward but needs supervision

( ) 0 loses balance while trying/requires external support

9. PICK UP OBJECT FROM THE FLOOR FROM A STANDING POSITION

INSTRUCTIONS: Pick up the shoe/slipper, which is in front of your feet.

( ) 4 able to pick up slipper safely and easily

( ) 3 able to pick up slipper but needs supervision

( ) 2 unable to pick up but reaches 2-5 cm(1-2 inches) from slipper and keeps balance independently

( ) 1 unable to pick up and needs supervision while trying

( ) 0 unable to try/needs assist to keep from losing balance or falling

10. TURNING TO LOOK BEHIND OVER LEFT AND RIGHT SHOULDERS WHILE STANDING

INSTRUCTIONS: Turn to look directly behind you over toward the left shoulder. Repeat to the right. (Examiner may pick an object to look at directly behind the subject to encourage a better twist turn.)

( ) 4 looks behind from both sides and weight shifts well

( ) 3 looks behind one side only other side shows less weight shift

( ) 2 turns sideways only but maintains balance

( ) 1 needs supervision when turning

( ) 0 needs assist to keep from losing balance or falling

11. TURN 360 DEGREES

INSTRUCTIONS: Turn completely around in a full circle. Pause. Then turn a full circle in the other direction.

( ) 4 able to turn 360 degrees safely in 4 seconds or less

( ) 3 able to turn 360 degrees safely one side only 4 seconds or less

( ) 2 able to turn 360 degrees safely but slowly

( ) 1 needs close supervision or verbal cuing

( ) 0 needs assistance while turning

12. PLACE ALTERNATE FOOT ON STEP OR STOOL WHILE STANDING UNSUPPORTED

INSTRUCTIONS: Place each foot alternately on the step/stool. Continue until each foot has touched the step/stool four times.

( ) 4 able to stand independently and safely and complete 8 steps in 20 seconds

( ) 3 able to stand independently and complete 8 steps in > 20 seconds

( ) 2 able to complete 4 steps without aid with supervision

( ) 1 able to complete > 2 steps needs minimal assist

( ) 0 needs assistance to keep from falling/unable to try

13. STANDING UNSUPPORTED ONE FOOT IN FRONT

INSTRUCTIONS: (DEMONSTRATE TO SUBJECT) Place one foot directly in front of the other. If you feel that you cannot place your foot directly in front, try to step far enough ahead that the heel of your forward foot is ahead of the toes of the other foot. (To score 3 points, the length of the step should exceed the length of the other foot and the width of the stance should approximate the subject's normal stride width.)

( ) 4 able to place foot tandem independently and hold 30 seconds

( ) 3 able to place foot ahead independently and hold 30 seconds

( ) 2 able to take small step independently and hold 30 seconds

( ) 1 needs help to step but can hold 15 seconds

( ) 0 loses balance while stepping or standing

14. STANDING ON ONE LEG

INSTRUCTIONS: Stand on one leg as long as you can without holding on.

( ) 4 able to lift leg independently and hold > 10 seconds

( ) 3 able to lift leg independently and hold 5-10 seconds

( ) 2 able to lift leg independently and hold L 3 seconds

( ) 1 tries to lift leg unable to hold 3 seconds but remains standing independently.

( ) 0 unable to try of needs assist to prevent fall

( ) TOTAL SCORE (Maximum = 56)

THE MINI – MENTAL STATE EXAM

Patient ……………………

Examiner ……………………..

Date ……………………

Maximum	Score	Orientation
5	( )	what is the (year) (season) (date) (day) (month)
5	( )	Where are we (state) (country) (town) (hospital) (floor)
		Registration
3	( )	Name 3 objects: 1 second to say each. Then ask the Patient all 3 after you have said them. Give 1 point for each correct answer. Then repeat them until him/her leans all 3.Count trials and record. Trials……………….
		Attention and calculation
5	( )	Serial 7, s.1 point for each correct answer. Stop after 5 Answers. Alternatively spell word backwards.
		Recall
3	( )	Ask for the 3 objects repeated above. Give 1 point for Each Correct answers.
		Language
2	( )	Name a pencil and watch
1	( )	Repeat the following" No ifs, ands or buts."
3	( )	Follow a 3-stage command

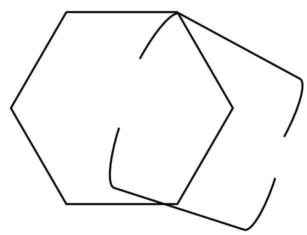
“Take a paper in your hand, fold it in half and put it on the floor”

1 ( ) Read and obey the following

CLOSE YOUR EYES

1 ( ) Write a sentence

1 ( ) Copy the design shown



…………………. Total score

ASSESS level of consciousness along a continuum ………………..

Alert Drowsy Stupor Coma

ANNEXURE IV

MASTER CHART

DEMOGRAPHIC PROFILE OF EXPERIEMNTAL GROUP 1

CONVENTIONAL PHYSIOTHERAPY WITH CORE STABILITY STRENGTH EXERCISE

			TIS SCORE	TIS SCORE	BBS SCORE	BBS SCORE
S.No	**Age**	**Sex**	**Pre test score**	**Post test score**	**Pre test score**	**Post test score**
1	51	F	7	8	17	23
2	55	F	10	11	18	15
3	60	M	8	8	13	24
4	56	F	5	6	16	20
5	58	M	9	12	11	18
6	57	F	7	10	18	24
7	62	M	11	4	18	20
8	63	M	6	7	15	24
9	58	M	9	10	20	25
10	62	M	10	12	22	24
11	55	M	7	14	23	24
12	58	M	12	14	16	20
13	50	M	7	10	12	16
14	60	M	9	15	15	18
15	59	M	8	10	16	23
Mean	**57.6**		**8.3**	**10.06**	**16.66**	**21.2**

The total number of patients in the experimental group 1 was 15 which include 11 males and 4 females with a mean age of 57.6 years. Mean post test scores of experimental group 1 group for TIS is 10.66 and for BBS is 21.2.

DEMOGRAPHIC PROFILE OF EXPERIEMNTAL GROUP 2

CONVENTIONAL PHYSIOTHERAPY WITH TRUNK STABILIZATION EXERCISE

			TIS SCORE	TIS SCORE	BBS SCORE	BBS SCORE
S.NO	**Age**	**Sex**	**Pre test score**	**Post test score**	**Pre test score**	**Post test score**
1	54	M	8	18	18	42
2	50	M	7	20	15	39
3	53	M	8	22	12	40
4	56	F	11	20	20	39
5	62	F	12	17	17	41
6	58	M	9	18	12	40
7	66	M	7	18	14	39
8	63	M	10	20	19	42
9	57	F	12	16	18	35
10	51	M	11	18	11	38
11	58	M	5	19	9	38
12	50	M	11	20	17	43
13	54	M	7	18	19	44
14	60	M	9	16	13	45
15	54	M	8	18	11	39
Mean	**56.4**		**9**	**18.53**	**15**	**40.26**

The total number of patients in the experimental group 2 was 15 which include 12 males and 3 females with a mean age of 56.4 years**.** Mean post test scores of experimental group 2 for TIS are 18.53 and BBS is 40.26 respectively.